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# ***JPRS Report***

## **Science & Technology**

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***USSR: Earth Sciences***

26 FEBRUARY 1988

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SCIENCE & TECHNOLOGY  
USSR: EARTH SCIENCES

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OCEANOGRAPHY

UDC 551.463+551.464

DETERMINATION OF MEAN THERMOHALINE CHARACTERISTICS OF THE OCEAN

Moscow VESTNIK MOSKOVSKOGO UNIVERSITETA: SERIYA 5, GEOGRAFIYA in Russian No 3, May-Jun 87 (manuscript received 10 Mar 86) pp 65-71

[Article by S.A. Dobrolyubov]

[Abstract] There are two major approaches to determination of average hydrologic characteristics and energy potential of the ocean: averaging over the water area of the ocean using a file of data on the temperature and salinity of the water at standard depths after preliminary averaging for each latitude band or spherical square and construction of so-called volumetric T, S-diagrams, in which the volumes of water falling into certain intervals of temperature and salinity or T, S classes are summed for each selected station. The second method is simpler than the first in terms of volume of computation work because it does not require preliminary averaging of measurements. However, errors result from differences between hydrologic conditions of a specific survey and mean climatic characteristics. The error is calculated for the North Atlantic and Pacific Oceans. Results of previous computations of the mean temperature and salinity of the ocean obtained by different authors are compared. Mean temperatures and salinities for the Pacific, Atlantic and Indian Oceans and for the entire ocean are presented in a table. Differences in mean characteristics between ocean basins are analyzed.

References 13: 8 Russian, 5 Western.

6508/9716  
CSO: 1865/516

UDC 551.46.062.3

SPECTRAL REFLECTIVE CHARACTERISTICS OF SEA SURFACE

Leningrad VESTNIK LENINGRADSKOGO UNIVERSITETA, SERIYA 7: GEOLOGIYA, GEOGRAFIYA in Russian No 1, Mar 87 (manuscript received 21 Oct 86) pp 97-99

[Article by V.V. Kazaryan and V.P. Korovin]

[Abstract] A multichannel type SP-4 spectropolarimeter operating in the 400-760 nm band from an aircraft was used to measure the spectral brightness of the

sea surface and study the brightness variation as a function of various hydro-physical characteristics. It was found that the spatial resolution of the instrument increased with decreasing measurement altitude, but that this increased dispersion and standard deviation of the measured values. The spectral distribution of sea surface brightness differed for various water areas. Over the ocean there was a characteristic maximum at 470-490 nm, in littoral waters it is shifted to 490-535 nm. References: 3 Russian.

6508/9716  
CSO: 1865/502

UDC 551.465

#### ANISOTROPY OF MICROSTRUCTURAL EDDY MOTION IN SURFACE LAYER DURING CALM

Moscow DOKLADY AKADEMII NAUK SSSR in Russian Vol 292, No 4, Feb 87 (manuscript received 14 Oct 85) pp 975-977

[Article by Yu. B. Shaub, Pacific Ocean Oceanological Institute, Far Eastern Scientific Center, USSR Academy of Sciences, Vladivostok]

[Abstract] The use of vector measurements of resistivity variations  $\Delta \vec{\rho}(t)$  makes it possible to detect and register rotational motions of nonuniform water masses, including in the dynamic nonuniform surface layer. At scales of several centimeters the eddy disturbances detectable from the rotational motions of projections of the total vector  $\Delta \vec{\rho}_{xy}(t)$ ,  $\Delta \vec{\rho}_{xz}(t)$ ,  $\Delta \vec{\rho}_{zy}(t)$  onto the three corresponding coordinate planes do not have any dominant direction (microstructural rotational motions in general are anisotropic). However, during a cruise of the "Akademik A. Vinogradov" it was discovered that during a calm the rotation of the  $\Delta \vec{\rho}_{xz}$  and  $\Delta \vec{\rho}_{zy}$  vectors decreases relatively in the vertical planes and rotation of the  $\Delta \vec{\rho}_{xy}$  vector in the horizontal plane is dominant. This phenomenon was studied using experimental  $\Delta \rho_i(t)$  records containing 512 discrete readings at time intervals 0.1 or 1 s. Centered values of the  $\Delta \rho_i$  variations were used in finding the angles  $\alpha_{xy}$  determining the position of projections of the  $\Delta \vec{\rho}$  vector ( $\Delta \vec{\rho}_{xy}$ ,  $\Delta \vec{\rho}_{xz}$ ,  $\Delta \vec{\rho}_{zy}$ ) on the corresponding coordinate planes. The behavior of the  $\alpha(t)$  angles during a calm also varied considerably. Analysis of these and other data confirmed the possibility of using  $\Delta \vec{\rho}(t)$  vector measurements for studying the characteristics of dynamics of water masses in the surface layer. Such measurements make it possible to trace the formation of anisotropic microstructural eddy motion in the horizontal plane during a calm and its subsequent destruction upon restoration of wind waves. Figures 2; references: 2 Russian.

5303/9716  
CSO: 1865/299

UDC 551.465:629.78

MUSHROOM-SHAPED CURRENTS (EDDY DIPOLES) UNDER ROTATION AND STRATIFICATION CONDITIONS

Moscow DOKLADY AKADEMII NAUK SSSR in Russian Vol 292, No 4, Feb 87 (manuscript received 28 Oct 85) pp 971-974

[Article by A. I. Ginzburg, A.G. Kostyanoy, A.M. Pavlov and K.N. Fedorov, Oceanology Institute imeni P.N. Shirshov, USSR Academy of Sciences, Moscow]

[Abstract] The mushroom-shaped currents detected from satellite images are a combination of narrow jet flows and plane eddy dipoles. A study was made to clarify the following aspects of this phenomenon: behavior of eddy dipoles under different conditions related to the presence or absence of stratification and different methods for inducing a disturbance allowing the possibility of a change in the sign and intensity of a relative angular momentum locally introduced into a fluid rotating as a solid body. The experimental apparatus included a rotating platform and a cylindrical basin filled with fresh water or a two-layer (saline-fresh) fluid which was spun in a clockwise direction until solid-body rotation was attained. The experimental configuration corresponded to an "f-plane" for which the  $\beta$ -effect due to parabolic level curvature is negligible. A dye was employed to facilitate observation of disturbance development. Various means were used to generate disturbances. The experiments revealed that in a fluid rotating system making it possible to stimulate currents on the f-plane any of the various types of local disturbance in either a uniform or stratified fluid results in the formation of an eddy dipole or dipoles. The experimental data suggest that in a rotating fluid system eddy dipoles constitute a natural universal reaction of a fluid to any local disruption of its solid-body nature of rotation. This further reinforces the opinion that a mushroom-shape configuration of nonstationary currents in the ocean surface layer (where such disturbances are most frequent) is universal. Figure 1; references 7: 5 Russian, 2 Western.

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CSO: 1865/299

UDC 551.465.73

ESTIMATES OF OCEAN-ATMOSPHERE THERMAL INTERACTION IN GULF STREAM ENERGY-ACTIVE TEST RANGE IN WINTER OF 1984

Moscow IZVESTIYA AKADEMII NAUK SSSR: FIZIKA ATMOSFERY I OKEANA in Russian Vol 23, No 3, Mar 87 (manuscript received 18 Jul 84, after revision 21 Apr 86) pp 309-313

[Article by S.S. Yefimov, G.G. Panteleyev and Ye.V. Semenov, Oceanology Institute, USSR Academy of Sciences]

[Abstract] Data on the temperature and salinity fields collected during the 38th cruise of the "Akademik Kurchatov" were used in an analysis of the

hydrological situation in the Gulf Stream energy-active test range ( $35^{\circ}$ - $39^{\circ}30'N$ ,  $64^{\circ}-71^{\circ}W$ ) in the winter of 1984. Two complete hydrological surveys of these fields were made (72 and 64 stations at depths to 2,000 m). The first survey was from 28 December 1983 to 17 January 1984 and the second from 17 February to 8 March 1984). The distance between stations was 30 miles. The grid used measured  $15 \times 10$  points of intersection horizontally with a uniform interval of  $0.5^{\circ}$  with 12 vertical levels: 0, 20, 50, 100, 150, 200, 400, 700, 1,000, 1,500, 3,000 and 5,000 m. Eulerian and Lagrangian descriptions of the motion of particles were used in estimating thermal interactions between the ocean and atmosphere. Maps were constructed showing the heat flows at the ocean surface for the end of the first and second surveys. The main region of heat transfer into the atmosphere is the Gulf Stream flow proper, evidently being attributable to the more intensive mixing of the upper layer and more active heat transfer by the cooling ocean surface. The intensity of the heat flow in this area was up to  $960 \text{ W/m}^2$  for the first survey and up to  $1,350 \text{ W/m}^2$  for the second. The regions where the ocean receives heat are situated to the north of the Gulf Stream jet and in the southwestern and eastern parts of the test range. The heat flow from the atmosphere to the ocean is less than the opposite flow by a factor of  $\sim 1.5$  for the first survey and about  $\sim 2$  for the second survey. Figures 2; references 3: 1 Russian, 2 Western.

5303/9716  
CSO: 1865/277

UDC 551.466.38

#### DETERMINING LANGMUIR CIRCULATION PARAMETERS ON BASIS OF SIMILARITY THEORY

Moscow IZVESTIYA AKADEMII NAUK SSSR: FIZIKA ATMOSFERY I OKEANA in Russian  
Vol 23, No 3, Mar 87 (manuscript received 31 May 85, after revision 19 Sep 85)  
pp 293-299

[Article by V.P. Krasitskiy and B.N. Filyushkin, Oceanology Institute,  
USSR Academy of Sciences]

[Abstract] A variant of similarity theory is proposed for describing Langmuir circulations. The determining parameters used were mean wind speed at the sea surface, mean height of wind waves, frequency of the wave spectrum maximum and corresponding wave number, and kinematic coefficient of turbulent viscosity of water. It is shown that when using this set of determining parameters the universal functions of similarity theory are dependent on only a single argument, the dimensionless frequency of the wave spectrum maximum. An analysis of observational data indicated a significant dependence of the characteristics of Langmuir circulations on this dimensionless argument. It is evident that the degree of development of waves (dependence on the duration of wind and fetch) is important. It is now possible to formulate the main requirements for carrying out in situ study of such circulations: in addition to measuring the main geometrical characteristics of circulations and rates of subsidence and upwelling of water in cells, it is necessary to make simultaneous instrumental measurements of wind waves, as well as wind speed

over the sea. Synchronous vertical measurements of the distribution of hydrophysical characteristics make possible a more complete study of the role of circulations in the formation of active layer structure. Semi-empirical relationships between the thickness of the surface quasi-homogeneous layer and the width of Langmuir circulation bands make it possible, using phenomena easily observable at the sea surface, to predict individual characteristics of upper ocean layer thermal structure. Figures 2; references 14: 6 Russian, 8 Western.

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CSO: 1865/277

UDC 536.758;535.36;539.171;541.8

THERMODYNAMIC THEORY OF FLUCTUATIONS AND RAYLEIGH LIGHT SCATTERING IN SOLUTIONS

Moscow VESTNIK MOSKOVSKOGO UNIVERSITETA: SERIYA 2, KHIMIYA in Russian  
Vol 28, No 1, Jan-Feb 87 (manuscript received 4 Sep 85) pp 54-61

[Article by V. A. Durov, Physical Chemistry Department, Moscow University]

[Abstract] Research on Rayleigh light scattering yields much information on the thermodynamic and kinetic properties of fluid systems, their molecular structure and the mechanisms of its restructuring in the course of thermal motion. This study is limited to the isotropic component of Rayleigh light scattering. It is shown that computations of the intensity of scattered light within the framework of macroscopic theory essentially involves computation of the mean squares and mean products of fluctuations of solution parameters. The article gives computations of fluctuations of a number of parameters of solutions of interest in the theory of Rayleigh light scattering using the methods of the thermodynamic theory of fluctuations. It was found that the expressions for fluctuations of such intensive parameters as temperature and pressure in solutions coincide with the corresponding expressions for single-component systems. The expressions for fluctuations of extensive parameters (numbers of mols of components and energy) and such intensive variables as density are different in solutions and pure fluids. These and other results made it possible to derive general expressions for the intensity of the isotropic component of Rayleigh light scattering in solutions. These expressions can also be used in studying the influence of fluctuations on a number of other thermodynamic properties of solutions. References 19: 10 Russian, 9 Western.

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CSO: 1865/296

UDC 551.463.5

RESEARCH ON INFLUENCE OF INDIVIDUAL SEA WATER COMPONENTS ON SPECTRAL  
BRIGHTNESS COEFFICIENT OF OUTGOING RADIATION

Minsk ZHURNAL PRIKLADNOY SPEKTROSKOPII in Russian Vol 46, No 1, Jan 87  
(manuscript received 19 Jul 85) pp 80-86

[Article by Ye. K. Naumenko]

[Abstract] There is a correlation between phytoplankton content and the brightness of radiation emanating from the water. However, the correlations obtained by different authors differ considerably (each of them is applicable only for a specific research region). A study was therefore made of the factors exerting an influence on the brightness of outgoing radiation which cannot be experimentally controlled. The basis for the study was an optical model of sea water, including the spectral properties of water itself, dissolved organic matter and hydrosol, constituting a two-component mixture of particles of mineral and biological origin. Formulas are derived which can be used in computing the spectral brightness coefficients for different  $M_i$  (mass concentrations of particles). An analysis was made to determine the influence of individual components on the spectral brightness coefficient value. The analysis was made for directions of illumination and observation close to the optimal conditions for detecting color contrasts in a visual study of the sea surface from space in the observation plane perpendicular to the plane of the solar vertical. Important information was obtained concerning the contributions of these components. For example, particles of phytoplankton with concentrations  $M_2 \leq 6 \text{ g/m}^3$  and particles of yellow matter with  $M_3 \leq 1 \text{ g/m}^3$  exert virtually no influence on the brightness coefficient for  $\lambda \geq 0.6 \mu\text{m}$  and the spectral dependence  $\rho(\lambda)$  is determined by the optical properties of pure water and the content of suspended mineral matter.

Figures 3; references 15: 11 Russian, 4 Western.

5303/9716  
CSO: 1865/295

UDC 551.242.2:551.263

RELATIONSHIP BETWEEN OCEANIC GEOLOGICAL FORMATIONS AND TECTONIC STRUCTURES

Moscow GEOTEKTONIKA in Russian No 2, Mar-Apr 87 (manuscript received 9 Apr 85)  
pp 35-45

[Article by I.O. Murdmaa, Oceanology Institute imeni P.P. Shirshov]

[Abstract] This review of information published in recent years makes it clear that each of the major structural elements of the oceanic crust (mid-oceanic ridges, ocean floor basins and marginal oceanic mobile zones) is characterized by a specific set of magmatic and sedimentary formations. There is a definite oceanic type of crust and lithosphere. There is a distinctive combination of predominantly abyssal (pelagic or adjacent to the continents) sedimentary formations with specific magmatic formations of the oceanic crust

belonging to the ophiolitic association. On the other hand, in the marginal oceanic mobile zones, where the oceanic crust is destroyed and transformed into a continental crust, there is a special group of sedimentary formations associated with both the ophiolites of the oceanic crust and with an island arc complex of magmatic rocks of the calc-alkali ("andesite") series. Each of the major structural elements of the oceanic crust in the evolution series from a spreading zone (mid-oceanic mobile zone) through an oceanic plate plunged to abyssal depths to a subduction zone is characterized by its own formation types, making it possible to reconstruct these structures themselves, and also their stages of evolution in the past. As a result of the lateral movement of lithospheric plates from the spreading axis to the subduction zone the lateral series of formations in each time section is duplicated in a vertical series of the sedimentary cover on the ocean periphery where crustal age is most ancient. Figures 2; references 29: 15 Russian, 14 Western.

5303/9716  
CSO: 1865/274

UDC 550.834:681.3(26)

#### NUMERICAL MODELING OF WAVE MIGRATION OF SEISMIC DATA

Novosibirsk GEOLOGIYA I GEOFIZIKA in Russian No 2, Feb 87 (manuscript received 6 May 85) pp 99-106

[Article by V.V. Perekhvatov, Yu.A. Byakov, V.A. Kemelman and G.F. Seleznev, Yuzhmorgeologiya Production Association, Gelendzhik]

[Abstract] A study was made of the applicability of wave migration for processing time sections obtained in abyssal zones of the world ocean. Numerical modeling of wave fields was carried out using materials collected in the course of work along the Angolan-Brazilian geotraverse. Much of this geotraverse intersects the Mid-Atlantic Ridge and adjacent regions where ocean depths vary in the range 3-5 km due to the great dissection of bottom relief. Most of the time sections for the geotraverse are characterized by a strong background of regular noise which in some cases virtually completely masks the images of useful structures and the wave pattern is very difficult to interpret. The wave migration procedure was used for transforming the time sections into seismic images of the medium, thereby simplifying the wave field. An algorithm was written for processing time sections by this procedure. Several examples of application of the algorithm are presented. These examples show that the wave migration procedure is an effective tool for retrieving the structure of the upper part of the section, including the bathymetric characteristics of the ocean floor, but the deep boundaries are retrieved with distortions attributable to inadequate allowance for the influence of the upper part of the section. Figures 4; references 12: 9 Russian, 3 Western.

5303/9716  
CSO: 1865/273

INITIAL THERMOELECTROMOTIVE FORCES OF MERCURY SULFATE ELECTRODE ON THERMAL DIFFUSION PROPERTIES OF LITHIUM, SODIUM, POTASSIUM, MAGNESIUM AND CADMIUM SULFATES

Kiev UKRAINSKIY KHMICHESKIY ZHURNAL in Russian Vol 53, No 3, Mar 87  
(manuscript received 18 Mar 85) pp 280-285

[Article by P. Ya. Tishchenko, Pacific Ocean Oceanological Institute, Vladivostok]

[Abstract] The initial thermoelectromotive force method is a simple indirect means for evaluating the thermal diffusion properties of electrolytes and its applicability is not limited by the sign on the Soret coefficient. The method can be used in determining the thermal diffusion properties of electrons in the range of ionic forces from 0.1 to 1 (between the upper limit of the conductometric method and the lower limit of the optical method). With this taken into account, experimental measurements were made of the initial thermoelectromotive forces of a mercury sulfate electrode in  $\text{Li}_2\text{SO}_4$ ,  $\text{Na}_2\text{SO}_4$ ,  $\text{K}_2\text{SO}_4$ ,  $\text{MgSO}_4$  and  $\text{CdSO}_4$  solutions as a function of temperature and ionic force and computations were made of thermal diffusion properties of these electrolytes using a modified computation method. The basis for computing the thermodiffusion properties of electrolytes was the theory of thermoelectromotive forces proposed earlier by M.I. Temkin, et al. (ZHURN. FIZ. KHMII, 26, No 4, pp 500-508, 1952). The fundamental equation of this method is given and the essence of the method is outlined. It is shown that the mentioned fundamental equation is applicable only to electrolytes very close in nature. This article gives a method for computing the thermal diffusion properties of electrolytes which are very different in nature. The thermal diffusion properties in the range of low ionic forces are known for many electrolytes. It is shown that on the basis of these data and measurements of the initial thermoelectromotive forces it is possible to determine the thermal diffusion properties of electrolytes for a broad range of ionic forces. References 16: 3 Russian, 13 Western.

5303/9716  
CSO: 1865/293

PALEOMAGNETIC DIAGNOSIS OF PERMIAN-TRIASSIC OBIAN PALEOOCEAN

Moscow DOKLADY AKADEMII NAUK SSSR in Russian Vol 293, No 1, Mar 87 (manuscript received 17 Jun 86) pp 59-62

[Article by S.V. Aplonov, R.M. Demenitskaya and A.S. Monin, Corresponding Member, USSR Academy of Sciences, Oceanology Institute imeni P.P. Shirshov, USSR Academy of Sciences, Moscow]

[Abstract] A study is made of a case in which a lengthening spreading line penetrated from the ocean into a continent and, advancing into its interior,

caused asynchronous splitting and the formation of an oceanic lithosphere in a wedge-shaped expanding "crack," as in the contemporary Gulf of Aden. Based on the studies of many authors and an enormous quantity of raw data, it is concluded that the zone of formation of hydrocarbons in the area of the fading paleocean extends from its edges toward the axis and from lesser to greater depths with gradually increasing delay and with decreasing intensity of the process. This demonstrates and theoretically explains the spatial and genetic relationship between the major zones of oil and gas accumulation in Northwestern Siberia and stages in the evolution of the Permian-Triassic Obian Paleocean. Figure 1; references 7: 5 Russian, 2 Western.

6508/9716  
CSO: 1865/267

UDC 534.21+551.466

#### WAVE EQUATION FOR SOUND IN MEDIUM WITH SLOW CURRENTS

Moscow DOKLADY AKADEMII NAUK SSSR in Russian Vol 293, No 1, Mar 87  
(manuscript received 1 Apr 86) pp 63-67

[Article by O.A. Godin, Oceanology Institute imeni P.P. Shirshov, USSR Academy of Sciences]

[Abstract] Precise hydrodynamic equations are used in this study in deriving an equation for the propagation of sound in a three-dimensionally heterogeneous medium with arbitrary slow flow and certain approximate methods for solving the equation are analyzed. References 15: 9 Russian, 6 Western.

6508/9716  
CSO: 1865/267

UDC 551.465

#### NEGATIVE VISCOSITY IN GLOBAL CIRCULATIONS

Moscow DOKLADY AKADEMII NAUK SSSR in Russian Vol 293, No 1, Mar 87  
(manuscript received 11 Jul 86) pp 70-74

[Article by A.S. Monin, Corresponding Member, USSR Academy of Sciences, Oceanology Institute imeni P.P. Shirshov, USSR Academy of Sciences, Moscow]

[Abstract] Negative viscosity is the property of a static ensemble of random gas or liquid movements, describing the capability for transfer of a statistically averaged quantity of motion from an area in space where its density is less to an area in which it is greater. Kinetic energy is transferred from pulsating motion to averaged motion in the process. Negative viscosity is manifested in global circulation on the Sun, Jupiter and Saturn, as well as probably Uranus and Neptune, in the circulation of the Earth's atmosphere and the ocean and in the circulation of the upper layers of the Venusian atmosphere. Negative viscosity can explain a number of surprising peculiarities of global circulations on celestial bodies. References 14: 7 Russian, 7 Western.

6508/9716  
CSO: 1865/267

UDC 551.1

NUMERICAL RECONSTRUCTION OF CLIMATES IN LATE PALEOZOIC AND MESOZOIC

Moscow DOKLADY AKADEMII NAUK SSSR in Russian Vol 293, No 1, Mar 87 (manuscript received 18 Dec 85) pp 210-214

[Article by M. Ya. Verbitskiy, Leningrad Branch, Oceanology Institute imeni P.P. Shirshov, USSR Academy of Sciences]

[Abstract] The author employs a thermohydrodynamic model of a system consisting of glaciers, the ocean and the atmosphere, with a number of modifications, to reproduce the climates of the late Paleozoic and Mesozoic periods. The major modification is extension of the oceanic block of the model to cover the case of the actual distribution of the continents and ocean. The model of the ocean in the new version is a set of basins reflecting the paleocean, connected where necessary by straits. The oceans are represented by spherical rectangles and allow a good description of the global distribution of land and sea. Each ocean is divided vertically into the thermocline and abyssal layers, horizontally into open ocean and the western boundary layer. Currents are calculated by a simple method of total flows, with a compensating flow in the western boundary area. The heat conductivity equation in divergent form is integrated for each of four areas, producing a system of four unsteady one-dimensional heat conductivity equations for each ocean. The oceans exchange heat in a northern or southern circulation, the thermal mode of which is determined by the integral heat balance equation. The model of evolution of glaciation used in a previous work is extended to an arbitrary configuration of the continents, and iceberg flow is calculated based on the length of the shoreline where the icebergs enter the ocean. Figures 3; references 3: 2 Russian, 1 Western.

6508/9716  
CSO: 1865/267

UDC 551.463.6(267)

STUDY OF CHARACTERISTICS OF INTERNAL WAVES IN UPPER THERMOCLINE NEAR MASCARENE SUBMARINE RIDGE

Moscow OKEANOLOGIYA in Russian Vol 27, No 2, Mar-Apr 87 (manuscript received 19 Jun 85) pp 191-196

[Article by V.I. Burenkov and A.P. Vasilkov, Oceanology Institute imeni P.P. Shirshov, USSR Academy of Sciences, Moscow]

[Abstract] Results from observation of internal waves in the upper thermocline in a small area in the vicinity of Mascarene Ridge are studied. Measurements were made during the third cruise of the research vessel "Vityaz'", 10-19 September 1982, in an area with depth changes as great as 1.5 km per kilometre of horizontal distance. The observations revealed that the spectral density of short-period internal waves in the upper thermocline is

approximately an order of magnitude greater than the Garrett-Munk background spectrum and significantly greater than its modification previously suggested for the low latitudes. The spectral densities of movement of isotherms had maxima near  $10^{-1}$  c/min, with high coherence at that frequency with a vertical separation of up to 50-60 m. Outside this band of frequencies, coherence of displacement of the isotherms decreased to insignificance with a vertical separation of about 30 m or greater. Figures 5; references 13: 6 Russian, 7 Western.

6508/9716  
CSO: 1865/503

UDC 551.465.42(261)

#### PROPAGATION OF SUBSURFACE SALINITY MAXIMUM IN TROPICAL ATLANTIC

Moscow OKEANOLOGIYA in Russian Vol 27, No 2, Mar-Apr 87 (manuscript received 7 Aug 85; after revision, 22 Apr 86) pp 197-203

[Article by S. Ye. Navrotskaya and V.F. Dubravin, Atlantic Division, Oceanology Institute imeni P.P. Shirshov, USSR Academy of Sciences, Kaliningrad; Kaliningrad Technical Institute of the Fishing Industry]

[Abstract] Temperature and salinity indices of the northern tropical and equatorial water masses and the deep North Atlantic water mass were taken for the northern hemisphere and used in studying the spatial distribution of the subsurface salinity maximum between 30°N and 30°S, calculating the percent content in the core of the tropical water mass. The subsurface salinity maximum is formed primarily due to southern hemisphere water at the equator throughout the year, though there is a significant seasonal variation in the maximum near the equator in response to surface and subsurface currents. The topography of the subsurface salinity maximum is diagramed for summer and winter. In the spring, the dynamic relief of the maximum near the equator in the northern hemisphere is complicated by a doubling of the equatorial trough due to the dynamics of the Lomonosov Current associated with the weakened Southeast Trades. Figures 4; references 12: 5 Russian, 7 Western.

6508/9716  
CSO: 1865/503

UDC 551.465.41

ENERGY CHARACTERISTICS OF TURBULENT SPOTS IN STABLY STRATIFIED OCEAN

Moscow OKEANOLOGIYA in Russian Vol 27, No 2, Mar-Apr 87 (manuscript received 16 Jul 85) pp 184-190

[Article by I. Yu. Avdeyeva and V.S. Maderich, Hydromechanics Institute, Ukrainian Academy of Sciences, Kiev]

[Abstract] A relatively simple model of a turbulent spot in the deep layers of a stably stratified ocean is studied, allowing a description of the transformation of energy within the spot and comparison of the calculated results with results measured in the ocean and in the laboratory. Turbulence can be maintained over a long period when  $Ri < 0.25$ . Figures 4; references 14: 6 Russian, 8 Western.

6508/9716  
CSO: 1865/503

UDC 551.46:519.24(268)

SPACE-TIME ANALYSIS OF OCEANOGRAPHIC FIELDS BY MODIFIED EMPIRICAL ORTHOGONAL FUNCTIONS METHOD

Moscow OKEANOLOGIYA in Russian Vol 27, No 2, Mar-Apr 87 (manuscript received 16 Jul 85) pp 204-211

[Article by A.O. Artemyev, Arctic and Antarctic Scientific Research Institute, Leningrad]

[Abstract] The purpose of this research was to determine the characteristic dynamics of temperature and salinity anomalies in the Arctic Basin from year to year and to evaluate the possibility of their prediction. Studies were based on a modification of the widely used method of empirical orthogonal functions. Dynamics of the anomalies were discovered with periods of about 5 to 6 years. The expanded method of empirical orthogonal function analysis allows prediction of the dynamics of these variables, revealing peculiarities of their space-time structure which are not obvious when traditional analysis methods are used. The variations in temperature and salinity anomaly fields in the surface layer of the Arctic Basin are determined from year to year primarily by surface circulation of water, water exchange with the Arctic seas and the inflow of Pacific water. Figures 2; references 11: 9 Russian, 2 Western.

6508/9716  
CSO: 1865/503

UDC 581.526.325.04

MODELING INFLUENCE OF POLLUTING SUBSTANCES ON PRODUCTION OF ORGANIC MATTER  
BY PHYTOPLANKTON IN SITU IN EXPERIMENTS

Moscow OKEANOLOGIYA in Russian Vol 27, No 2, Mar-Apr 87 (manuscript received 19 Feb 85; after revision 13 Jun 85) pp 234-237

[Article by S.A. Sarkisova and I.A. Skripnik, Odessa Division, Economics Institute, Ukrainian Academy of Sciences]

[Abstract] Experiments were carried out in 1981-1983 for study of natural populations of microscopic algae in two areas of the Black Sea using sea water isolated in polymer film containers: 5-liter polyethylene bags, 50-liter polyethylene bags and 500-liter polyvinyl chloride spheres. The influence of chlorine, diesel fuel and surface-active agents in various dilutions on photosynthesis was studied. Chlorine was found to have the most toxic effect, with surfactants and diesel fuel approximately equal and less toxic than chlorine. Figures 3; references: 4 Russian.

6508/9716  
CSO: 1865/503

UDC 553.31:552.2:57

BIOGENIC COMPONENTS IN ABYSSAL FERROMANGANESE NODULES

Moscow OKEANOLOGIYA in Russian Vol 27, No 2, Mar-Apr 87 (manuscript received 30 Jan 85) pp 263-267

[Article by G. N. Baturin and A. Ya. Shevchenko, Oceanology Institute imeni P.P. Shirshov, USSR Academy of Sciences, Moscow]

[Abstract] This report gives results obtained by the authors in combined investigations of the composition and structure of ferromanganese nodules collected in various areas of the Pacific Ocean. Biogenic material, basically carbonaceous and silicaceous materials, the remains of foraminifera, coccoliths, radiolarians, diatoms, spiculae and bacterial cells were found in most nodules. Bacterial cells are quite broadly distributed among ferromanganese nodules, but additional information is needed to judge the true role of microorganisms in the formation of the nodules. The authors refer the question to American authors who have recently concluded that microbiological activity is quite important in the formation of the nodules. It is noted that there are no Soviet specialists in this area of marine microbiology to provide equivalent Soviet results. Figures 3; references 18: 10 Russian, 8 Western.

6508/9716  
CSO: 1865/503

UDC 581.526.325(269)

ACTUAL QUANTITIES OF PRIMARY PRODUCTION IN ANTARCTIC ZONE OF OCEAN

Moscow OKEANOLOGIYA in Russian Vol 27, No 2, Mar-Apr 87 (manuscript received 19 Feb 85) pp 301-310

[Article by E. Z. Samyshev, L.A. Vinogradova and L.P. Fetisov, Azov-Black Sea Scientific Research Institute of Fishing and Oceanography, Kerch]

[Abstract] Complex studies of the structure of Antarctic plankton in the Indian Ocean sector of the Antarctic have previously encountered the problem of underestimation of primary production when measured by the radiocarbon method. To provide more realistic values, the authors employed two estimation methods: A balance method based on consideration of the carbon budget in the major components of the seston and a calculation method based on a model of the production of phytoplankton developed by the authors. The mean ratio of calculated values of primary production to measured values in the photic layer was 8.4, varying from 0.3 to 50.4. The real values of production of phytoplankton were at least an order of magnitude higher than the measured values. Figures 3; references 24: 17 Russian, 7 Western.

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CSO: 1865/503

UDC 591.52.12(268)

ECOLOGY OF MASSIVE AGGREGATIONS OF COLONIAL DIATOM ALGAE UNDER DRIFTING ARCTIC ICE

Moscow OKEANOLOGIYA in Russian Vol 27, No 2, Mar-Apr 87 (manuscript received 11 Nov 85) pp 3178-321

[Article by I.A. Melnikov and L.L. Bondarchuk, Oceanology Institute imeni P.P. Shirshov, USSR Academy of Sciences, Moscow]

[Abstract] Information is given on the morphology, ecology and propagation of aggregations of algae inhabiting the lower surface of the Arctic ice cover, based on observations made by divers from the SP-23 drift station in August 1977 and the SP-22 drift station in July 1980. Photographs and a cross-sectional drawing illustrate the aggregations studied. Although the aggregations occupy a small area, their contribution to biological productivity is significant, similar to that of macrophytes in the sublittoral area. Figures 2; references 9: 4 Russian, 5 Western.

6508/9716  
CSO: 1865/503

COMPARATIVE CATCH RATES OF LARGE VOLUME BATHOMETERS AND VERTICAL HAUL  
PLANKTON NETS

Moscow OKEANOLOGIYA in Russian Vol 27, No 2, Mar-Apr 87 (manuscript received 4 Mar 86) pp 329-337

[Article by M. Ye. Vinogradov, M.V. Flint, E.A. Shushkina, V.N. Tutubalin and Ye.G. Uger, Oceanology Institute imeni P.P. Shirshov, USSR Academy of Sciences, Moscow]

[Abstract] Different types of equipment for gathering of plankton preferentially catch plankton of different size ranges. This article compares the catching qualities of a 150-l bathometer and vertically hauled plankton nets based on parallel collections taken at 41 locations in the Pacific Ocean and Black Sea. Tables list the numbers and biomass of various mesoplankton components in the 0-200 m depth layer determined by bathometers and nets in waters with varying levels of production in the Pacific Ocean. References 11: 10 Russian, 1 Western.

6508/9716  
CSO: 1865/503

SIZE STRUCTURE OF MICROPLANKTON: FRACTIONATION METHOD AND ANALYTIC CAPABILITIES

Moscow OKEANOLOGIYA in Russian Vol 27, No 2, Mar-Apr 87 (manuscript received 3 Jul 85, after revision 25 Nov 85) pp 338-343

[Article by A.S. Lopukhin, D.K. Krupatkina, Yu.G. Kamenir and E.A. Chepurnova, Institute of Biology of the Southern Seas, Ukrainian Academy of Sciences, Sevastopol]

[Abstract] A study was made of the size structure of a plankton community, represented as a set of size spectra, each of which describes the distribution of one of the functional or morphological characteristics (ATP, chlorophyll, primary production, number of cells, biomass, volume, total surface area) by sizes of groups of microplankton separated into ranges of change of cell sizes. An original filtering device achieving this separation is described and diagramed. Examples of application of the resulting size spectra are presented. The quantitative ratio of ATP, chlorophyll or any other characteristic studied, retained or passed by a specific filter, depends on the distribution of the characteristic by sizes of microplankton fractions, which will be different in different types of waters. The reliability and comparability of determinations can be improved by selecting a filter which considers the distribution of the characteristic in question among size fractions. Figure 1; references 16: 8 Russian, 8 Western.

6508/9716  
CSO: 1865/503

INTRATHERMOCLINE LENS OF MEDITERRANEAN WATER IN TROPICAL NORTH ATLANTIC

Moscow OKEANOLOGIYA in Russian Vol 27, No 2, Mar-Apr 87 (manuscript received 6 Mar 86) pp 165-175

[Article by V.D. Yegorikhin, Yu.A. Ivanov, V. G. Kort, M.N. Koshlyakov, Yu.F. Lukashev, Ye.G. Morozov, I.M. Ovchinnikov, V.T. Paka, T.B. Tsybaneva, I.F. Shadrin and S.M. Shapevalov, Oceanology Institute imeni P.P. Shirshov, USSR Academy of Sciences, Moscow]

[Abstract] Intrathermocline anticyclonic vortices located completely within the intermediate layer of the ocean may carry waters from the area of their formation within themselves for hundreds of thousands of kilometers. Traces of such "lenses" containing Mediterranean water have been found in the subtropical North Atlantic, and some have been extensively studied. A lens of Mediterranean water with record values of temperature and salinity was found and studied in detail in April-June 1985 in the eastern tropical North Atlantic near 20°N, 37°W. Charts illustrate the distribution of temperature, salinity and water density in this formation on 21-22 June 1985. The lens was apparently formed on the outer or oceanic edge of the intrusive flow of Mediterranean water moving generally westward, then northward, along the continental slope along the southwestern and western coast of the Iberian Peninsula as a continuation of the deep current through the Strait of Gibraltar. Movement of perhaps as many as several hundred such lenses per year is probably the main mechanism of penetration of Mediterranean waters into the deep Atlantic Ocean. Figures 10; references 16: 10 Russian, 6 Western.

6508/9716  
CSO: 1865/503

MICROBIOLOGICAL FORMATION OF METHANE IN BERING SEA SEDIMENTS

Moscow MIKROBIOLOGIYA in Russian Vol 55, No 3, May-June 87  
(manuscript received 10 Oct 84) pp 490-495

[Article by S. N. Gorlatov, V. F. Galchenko and V. G. Tokarev, Institute of Biochemistry and Physiology of Microorganisms, USSR Academy of Sciences, Pushchino]

[Abstract] Processes of low-temperature formation of methane by a specific group of methane-forming bacteria in sediments are of great interest both from the standpoint of investigation of carbon cycle processes and for the solution of practical problems such as the development of methods of search for oil and gas deposits in the ocean. The purpose of this work was investigation of processes of microbiological formation of methane in the bottom sediments of various regions of the Bering Sea. Materials for the study were collected during the 26th cruise of the scientific research vessel "Akademik Shirshov" in June-July 1981 in areas of the Komandorskiy and Aleutian trenches as well as on the eastern shallow shelf. A radioactive isotope method was used to study the intensity of the processes of microbiological formation of methane in the bottom sediments, showing that for most of the sediments low values of the redox potential are possible, although the population of methanogenic microflora is not over a few specimens per cubic centimeter. Methanogenesis processes were found, however, in all specimens studied, with an intensity of  $6 \cdot 10^{-3}$ - $680 \cdot 10^{-3}$   $\mu\text{g C/kg day}$ . Most of the methane is formed from  $\text{CO}_2$ , the remainder from the methyl group of acetate. The total methanogenesis rate was 5 to 10 times greater in deeper sediments,  $109.7$ - $301.5 \mu\text{g C/m day}$ . Figures 3; references 9: 6 Russian, 3 Western.

6508/12955  
CSO: 1865/253

UDC 551.466.81

## GENERATION OF SHORT-PERIOD INTERNAL WAVES BY WIND PULSATIONS

Moscow IZVESTIYA AKADEMII NAUK SSSR: FIZIKA ATMOSFERY I OKEANA in Russian Vol 23, No 2, Feb 87 (manuscript received 24 Dec 85, after revision 15 Apr 86) pp 179-185

[Article by V. A. Ivanov, A. D. Lisichenok and M. S. Nemirovskiy, Marine Hydrophysics Institute, Ukrainian Academy of Sciences]

[Abstract] A field study of the space-time characteristics of short-period internal waves and their relationship to variations in wind speed is described. Materials are presented from field observations on the Black Sea shelf in Bulgaria during the "Diffusion-84" international experiment. Space-time spectra of internal waves were obtained as wind speeds increased, showing good agreement of wind speed and internal wave pulsations and indicating that oscillations with high wave number values are first excited. The three-dimensional scale of waves is the same for various time frequencies. Waves propagate perpendicular to the wind direction. An increase in wind speed in the lowest layer of atmosphere thus generates short-period internal waves in the seasonal thermocline, propagating perpendicular to the direction of the wind speed with high wave number values. Figures 4; references 13: 9 Russian, 4 Western.

6508/12955  
CSO: 1865/259

UDC 551.46

## DYNAMICS OF SYNOPTIC OCEAN EDDIES

Moscow VESTNIK AKADEMII NAUK SSSR in Russian No 2, Feb 87 pp 22-35

[Article by M. N. Koshlyakov, doctor of physical and mathematical sciences]

[Abstract] This article briefly presents the results of an analysis of the properties of synoptic eddies observed during the Soviet-American POLYMODE project, covering their origin, dynamics and interaction with large-scale ocean currents. The basis of the Soviet work was 19 anchored

autonomous buoy stations in a equilateral triangle grid spaced at distances of 72 km, with the center of the grid at 29°N, 70°W. The area covered is in the vicinity of the Gulf Stream, where large quantities of heat are transmitted from the ocean to the atmosphere in winter. The interaction of Gulf Stream eddies with each other and with the main current is described. Additional work was done in 1982-1983 in the Subantarctic. The behavior of two cyclonic eddies in this area is described. It is emphasized that there is a direct inter-relationship between oceanic eddies and atmospheric processes. Bottom relief is said to directly influence the formation of eddies, although the eddy pattern does not repeat from year to year in the same area. Figures 7; references: 1 Russian.

6508/12955  
CSO: 1865/235

UDC 536.24:532.517

TURBULENT TRANSFER OF MOMENTUM AND HEAT IN BOUNDARY LAYER OF FLUID BEYOND AN OBSTACLE (1. HYDRODYNAMIC CHARACTERISTICS)

Vilnius TRUDY AKADEMII NAUK LITOVSKOY SSR: SERIYA B: KHIMIYA, TEKHNIKA, FIZICHESKAYA GEOGRAFIYA in Russian No 6, Dec 86 (manuscript received 6 Aug 85) pp 92-103

[Article by R. B. Shlyazhas and A. A. Shlanchyauskas, Institute of Physical and Technical Problems of Power Engineering, Lithuanian Academy of Sciences]

[Abstract] Experimental studies were carried out to analyze the distribution of mean velocity, correlation moments of velocity pulsations up to third order and balance terms in the energy equation in a turbulent boundary layer with separating flow around an obstacle situated on a plate. Mean velocity profiles, turbulent energy profiles, profiles of third-order correlation moments and turbulent energy dissipation profiles are presented in tabular form. It is found that the main source of the increase in turbulent energy in the boundary layer downstream from an obstacle is the shear layer. It is similar in energy transfer properties to a flat mixing layer developing in the initial portion of a flooded jet. Attachment of the flow involves redistribution of energy among velocity pulsation components. The energy of vertical pulsations is transferred to pulsation movement parallel to the wall, while the turbulent flow of momentum near the wall is reduced. Figures 6; references 8: 5 Russian, 3 Western.

6508/12955  
CSO: 1865/251

## ROLL COMPENSATION IN SHELF SURVEYS

Moscow GEODEZIYA I KARTOGRAFIYA in Russian Vol 3, Mar 87 pp 48-50

[Article by V. B. Yeliseyev, B. V. Yeliseyev and Ye. M. Zaytsev]

[Abstract] Two West German roll compensators intended to increase the accuracy of bottom surveying in shallow water were tested. The compensators generate a signal proportional to the vertical displacement resulting from rolling of the ship, which is used to improve the accuracy of the echo soundings recorded. Examples of diagrams produced with and without the roll compensators indicate that they increase the accuracy of depth measurements, allow determination of small details of bottom relief and improve bottom relief images, increasing the reliability of detection of deep anomalies. Survey can be made under wave conditions which would previously have been considered unsuitable for such work.

6508/12955  
CSO: 1865/276

UDC [528.716.1:527.61].088

## GENERALIZED EXPRESSION FOR RADIO NAVIGATION PARAMETER ERROR

Moscow GEODEZIYA I KARTOGRAFIYA in Russian No 3, Mar 87 pp 45-48

[Article by V. F. Ivashkevich (deceased) and V. S. Tregubov]

[Abstract] An analysis of various physical factors influencing the accuracy of radio navigation measurements in low-frequency systems such as Loran-C was made in deriving a generalized expression for the error in measuring the radio navigation parameter, which can be used in referencing objects during hydrographic and topographic-geodetic work on the continental shelf. All parameter measurement errors are considered to fall in three main groups: instrumental, noise in the measurement zone, and those caused by the influence of the environment on the radio wave propagation. An evaluation of measurement accuracy of the radio navigation parameter, since the correction for the propagation conditions for surface radio waves cannot be constant for the entire zone of action of the radio navigation system due to changing path length and effective conductivity, can be made using the equation derived in this article, which consists of three components: the rms measurement

error of the parameter and two mean square errors for excluding systematic components. This allows evaluation of accuracy in measuring the parameter both over the entire zone and in an individual region, permits quantitative estimation of each of the factors influencing parameter measurement error and allows determination of the degree to which the error in a receiver indicator corresponds to the maximum possible accuracy of radio navigation parameter measurement. Figures 2, references 7: 6 Russian, 1 Western.

6508/12955  
CSO: 1865/276

UDC 534.26

#### INCREASING RESOLUTION OF ACOUSTICAL SEA FLOOR IMAGES

Moscow DOKLADY AKADEMII NAUK SSSR in Russian Vol 292, No 3, Jan 87  
(manuscript received 5 Nov 85) pp 720-723

[Article by V. Kh. Kiriakov, Oceanology Institute imeni P. P. Shirshov,  
USSR Academy of Sciences, Moscow]

[Abstract] Some signal processing methods are discussed, the use of which in studies of acoustical images of the sea floor can increase their information content by increasing their resolution, the study was based on experimental materials from acoustical visualization of the sea floor performed during the 6th cruise of the research vessel "Akademik Mstislav Keldysh." The acoustical field of a monochromatic echo sounder returned by the sea floor was studied using a multiple-element antenna allowing determination of the acoustical field in an 8x8 array of points on an aperture, nodes on a rectangular equidistant grid. Aperture synthesis was used to improve resolution. An image constructed by autoregression is illustrated, showing that areas of strong reradiation can be more precisely discriminated without increasing the number of receiving elements either by aperture synthesis as the ship drifts or by the use of nonlinear spectral estimates, particularly by the autoregression method. The image example presented shows the good possibilities of nonlinear estimates, simpler than the synthetic aperture method, which requires registry of a sequence of positions as the acoustical field is measured. Figures 3; references 6: 3 Russian, 3 Western.

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CSO: 1865/279

UDC 551.465

LENS OF MEDITERRANEAN WATERS NEAR AMPERE AND JOSEPHINE SEAMOUNTS

Moscow DOKLADY AKADEMII NAUK SSSR in Russian Vol 292, No 3, Jan 87  
(manuscript received 2 Dec 85) pp 716-719

[Article by A. B. Zubin and R. V. Ozmidor, Oceanology Institute imeni P. P. Shirshov, USSR Academy of Sciences, Moscow]

[Abstract] A lens of Mediterranean intermediate waters was detected on the 42nd cruise of the research vessel "Akademik Kurchatov" between Ampere and Josephine Seamounts some 670 km to the west of the Strait of Gibraltar in mid-September 1985. The hydrological characteristics indicate that the Mediterranean waters had salinity 3.57 to 3.65/0/00, temperature 11.5 to 13.4°C, depth 450 to 1400 m, approximately half-way between the two seamounts. Additional measurements were made at 36°N while crossing the Mediterranean waters from east to west, confirming the existence of the lens of Mediterranean waters. The origin of the lens is probably related to non-uniformity of arrival of masses of Mediterranean waters through the Strait of Gibraltar, primarily with an orographic effect. The bottom relief in the studied area creates a sort of natural cup at the depth of the Mediterranean waters, a trough limited by the 4000-m isobath with free passage from the Strait of Gibraltar and narrow outlets between underwater formations along the way. Figures 2; references 5: 4 Russian, 1 Western.

6508/12955  
CSO: 1865/279

EXPERIENCE WITH AND WAYS TO UPGRADE ACCURACY OF HYDROMAGNETIC SURVEYS  
IN OCEAN

Moscow EKSPRESS-INFORMATSIYA. SERIYA: MORSKAYA GEOLOGIYA I GEOFIZIKA  
in Russian No 12, 1986 pp 1-4

[Article by N. N. Rzhevskiy, "Sevmorgeologiya" Geological Production Association]

**Abstract**] In geophysical magnetometric research there is a lack of consistency between the instrumental accuracy of measurements and the accuracy of compiled maps of the anomalous magnetic field. There also is a disproportion between the random and systematic errors of these maps. Because of this, the highly successful work of scientists and engineers in developing new instruments for measuring the magnetic field is largely defeated. A number of measures can be proposed for increasing the efficiency of hydromagnetic surveys in the ocean which can be used in the planning of work and the processing of measurement data. Methods for reducing random errors include the following: accelerated work on development and introduction of buoy magnetovariation stations, making possible use of a direct method for excluding variations; use of a statistical method for determining variations of the geomagnetic field using data from hydromagnetic surveys; use of a network of reference and repeated runs for successful use of indirect methods; allowance for the correlation of disturbances measured on a survey profile and at a magnetovariation station. Systematic errors can be reduced in the following ways: repeated measurements at any time and at any point in the ocean; representation of finalized maps or graphs in absolute values, in addition to maps of the anomalous field; construction of diagrams and maps of anomalies of secular variation on the basis of repeated observations for the purpose of introducing corrections; in magnetic cartography, elimination of the methods used for mathematical centering of the magnetic field along the profiles; organization of a data bank for all repeated observations for the purpose of annual revision of secular variation maps and tables; establishment of a world network of reference magnetometric oceanic profiles and preparation of regulations for supporting and maintaining this network.

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CSO: 1865/237

MECHANISM OF FORMATION OF PETROLEUM- AND GAS-BEARING BASINS IN PERSIAN GULF

Moscow IZVESTIYA AKADEMII NAUK SSSR: SERIYA GEOLOGICHESKAYA in Russian  
No 1, Jan 87 (manuscript received 4 Jul 85) pp 106-122

[Article by Ye. V. Artyushkov and M. A. Beer, Earth Physics Institute, USSR Academy of Sciences; All-Union Scientific Research Institute of Metrology and Standardization, Moscow]

[Abstract] The history of development and distribution of hydrocarbons in the petroleum- and gas-bearing basins of the Persian Gulf are described. In each of these basins during the Mesozoic-Cenozoic there were rapid sinkings unaccompanied by significant dilatation. In most regions the sinkings occurred repeatedly. The occurrence of rapid sinkings suggests that these basins are miogeosynclines or incompletely developed miogeosynclines, depending on total amplitude of the rapid sinkings. Crustal uplifts preceded most of the rapid sinkings. The rapid sinkings were apparently associated with destruction of the thin layer of the lower part of the crust upon contact with the anomalous mantle. The heat flow in the Arabian downwarp is or was considerably higher than in stable platform sedimentary basins with a great thickness of the lithosphere. This is probably attributable to the presence of a trap at the bottom of the lithosphere under the Arabian downwarp. This increased heat flow has ensured the maturing of petroleum and gas at shallow depths. The Persian Gulf basins are characterized by a high intensity of local tectonics, this being responsible for the formation of numerous petroleum and gas traps. It is far greater than over most of the area of adjacent platform sedimentary basins. The formation of faults, flexures and salt domes occurred for the most part in the Cretaceous and Cenozoic -- after onset of the rapid sinkings. The rapid sinkings resulted in formation of uncompensated, relatively deep-water downwarps, partially isolated from the ocean, in which reduction conditions developed with accumulation of sediments rich in organic matter, serving as excellent mother rocks for petroleum and gas. Subsequent deposition of sands, evaporites, clay shales and other rocks constituted good collectors and caprock. Figures 2; references 44: 28 Russian, 16 Western.

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CSO: 1865/223

UDC 551.465.15

VERTICAL TURBULENT TRANSFER OF MATTER IN THIN OCEAN SURFACE LAYER DURING  
DAYTIME HEATING

Moscow OKEANOLOGIYA in Russian Vol 27, No 1, Jan-Feb 87  
(manuscript received 22 Feb 85) pp 47-51

[Article by K. A. Korotenko, Oceanology Institute imeni P. P. Shirshov,  
USSR Academy of Sciences, Moscow]

[Abstract] The long-wave part of the solar radiation spectrum responsible for the heating of water is almost entirely absorbed in the upper 5-m layer of the ocean and this can give rise to considerable temperature (density) gradients. An increase in the density gradient during heating results in definite changes in the characteristics of vertical diffusion of impurities in this ocean layer. This effect was observed by the author during diffusion experiments in the Black Sea in June 1984 in which a dye was used. It was found that the penetration of matter into the depths of the ocean is dependent to a considerable degree on the nature of temperature field variability in the layer in the course of radiation heating. Three regimes of this process are defined; each of these is described and analyzed. These regimes are associated with the rate of increase in the temperature gradient in the layer of volumetric absorption of solar radiation. Examples of specific in situ experiments are given which confirm these conclusions. The formulas describing this process are derived. Despite idealization of the problem, its solution gives a number of characteristics of the process of vertical transfer of matter in the ocean accompanying daytime heating, this being a reflection of more general laws of the balance of kinetic energy of turbulence in a stratified fluid with a density (temperature) gradient changing in the course of daytime heating. Figures 2; references: 5 Russian.

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CSO: 1865/242

PHENOMENOLOGICAL DESCRIPTION OF EDDY REGISTERED IN GULF STREAM

Moscow OKEANOLOGIYA in Russian Vol 27, No 1, Jan-Feb 87  
(manuscript received 26 Dec 84, after revision 26 Apr 85) pp 25-29

[Article by V. A. Bubnov, N. P. Kuzmina and I. S. Podymov, Oceanology Institute imeni P. P. Shirshov, USSR Academy of Sciences, Moscow]

[Abstract] The 5th cruise of the "Vityaz" (28 February-2 March 1984) in part was carried out in the Gulf Stream frontal zone in a region of intensive meandering ( $38\text{--}40^\circ\text{N}$ ,  $62\text{--}67^\circ\text{E}$ ). Measurements were made with an STD complex to a depth of 1,000 m and a thermistor towed at the surface. Macro- and mesoscale characteristics of the zone were determined. A cyclonic eddy formation of relatively small horizontal dimensions, with anomalously low temperature and salinity and high orbital velocities, was discovered at the center of the meander. The measured parameters indicate that this eddy is a new type, not observed earlier in the frontal zone. The eddy had an elliptical shape with the longer axis oriented in a SW-NE direction. The horizontal scales of the formation at the 0 and 200-m horizons were about 60 and 30 miles respectively. The ship's drift rate was the same as the orbital velocity of eddy motion (about 2.5 knots); this eddy orbital motion is cyclostrophic, rather than geostrophic. Sections through the eddy reveal a sharp frontal nature of its boundaries. In the upper layer the horizontal temperature and salinity gradients attain  $2^\circ\text{C}/\text{mile}$  and  $0.2^\circ/\text{oo mile}$ . Numerous inversions on the temperature and salinity profiles indicate strong transfrontal heat and mass transfer in peripheral portions of the eddy. In the measurement region there are waters with a salinity of about  $34^\circ/\text{oo}$ , indicating that the observation region is penetrated by both slope and shelf waters. The mechanism of formation of this eddy may be similar to the generation of cyclones and anticyclones in the North Atlantic Current region. Figures 3; references 7: 4 Russian, 3 Western.

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UDC 551.465.11

CONTRIBUTION TO THEORY OF QUASIGEOSTROPHIC MOTIONS OF FINITE AMPLITUDE IN VISCOS STRATIFIED OCEAN

Moscow OKEANOLOGIYA in Russian Vol 27, No 1, Jan-Feb 87  
(manuscript received 10 Apr 85, after revision 20 Sep 85) pp 18-24

[Article by G. I. Shapiro, Oceanology Institute imeni P. P. Shirshov, USSR Academy of Sciences, Moscow]

[Abstract] A study was made of quasigeostrophic motions of finite amplitude (QMFA), with allowance for viscosity forces, in the approximation of a multi-layer-stratified fluid. A generalized quasigeostrophic equation is derived which describes motion of different spatial scales  $L$ : mesoscale ( $L \ll L_R$ ), synoptic ( $L \sim L_R$ ) and planetary ( $L \gg L_R$ ),  $L$  is the internal deformation radius. There are no restrictions on the amplitude of displacement of the isopycnic line. In the theoretical analysis two types of nonlinearity are examined: "dynamic," characterized by the Kibel number  $\xi = V_*/f_0 L$  ( $V_*$  is the typical horizontal velocity of the fluid  $f_0$  is the typical f value (Coriolis parameter)), and "kinematic," associated with finite deflection of the isopycnic line from its equilibrium position. This is characterized by the parameter  $\sigma = \zeta_*/h_0$ , where  $\zeta_*$  is the change in vertical distance between fixed isopycnic lines under the influence of a perturbation,  $h_0$  is the characteristic distance between them. The QMFA correspond to small  $\xi$  values and arbitrary  $\sigma$  values. Internal Ekman waves arising near density jumps play an important role in the dynamics of the QMFA. In this formulation, and with these considerations taken into account, an analysis was made of unsteady motion of finite amplitude in a layered-stratified viscous rotating fluid. The case of a three-layer fluid is examined in detail. It was found that under definite conditions the problem can be reduced to solution of one scalar equation which generalizes the known equation for evolution of quasigeostrophic potential vorticity. A classification of quasigeostrophic motions is proposed as a function of the relationship between the Kibel and Ekman numbers and the dimensionless amplitude of perturbations. Estimates for the rate of viscous degeneration of intrathermocline eddies are given. The temporal evolution and the three-dimensional field of velocities of an axisymmetric intrathermocline eddy are computed. Figure 1; references 15: 10 Russian, 5 Western.

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## NUMERICAL MODEL OF RAYLEIGH INSTABILITY AND SPIN-OFF EDDIES ON FRONTS

Moscow OKEANOLOGIYA in Russian Vol 27, No 1, Jan-Feb 87  
(manuscript received 29 Mar 85, after revision 25 Oct 85) pp 12-17

[Article by V. F. Kozlov and Ye. V. Yaroshchuk, Pacific Ocean Oceanological Institute, Far Eastern Scientific Center, USSR Academy of Sciences, Vladivostok]

[Abstract] A contour dynamics model of baroclinic instability of a front is proposed. It is represented in the form of a linear shear layer with constant vorticity within. Numerical experiments not only confirm the known Rayleigh instability criteria, but also make it possible to trace a decay (spin-off) process in a highly nonlinear stage in development of the process. This spin-off eddy phenomenon has been observed in the Florida Current. These are cyclonic eddies of an intermediate scales (with a diameter of several tens of kilometers) extending to a depth of 100-200 m. A linear analysis of stability and the numerical experiments described in the article show that such an unstable shear layer decays into a train of eddies (an analogue of the observed spin-off eddies), whereas the stable layer, in the case of perturbations of the boundaries, may experience deformations resembling the "tiled" structures observed in the ocean. It is shown that an extremely probable cause of appearance of spin-off eddies is shear barotropic instability on fronts, developing in the upper layer. An important and decisive stability parameter is the ratio of the width of the front to the characteristic length of the perturbation wave, evidently generated by synoptic processes in the atmosphere. It appears that the contour dynamics model can serve as an effective tool in modeling the dynamics of fronts and can be useful in interpreting satellite observation data. Figures 5; references 15: 7 Russian, 8 Western.

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CSO: 1865/242

RESEARCH ON TURBULENCE IN BOTTOM BOUNDARY LAYER IN OCEAN

Moscow OKEANOLOGIYA in Russian Vol 27, No 1, Jan-Feb 87  
(manuscript received 25 Nov 85) pp 5-11

[Article by V. N. Nabatov and R. V. Ozmidov, Oceanology Institute imeni P. P. Shirshov, USSR Academy of Sciences, Moscow]

[Abstract] The results of turbulence measurements in the bottom layer of the ocean made on the 42d cruise of the "Akademik Kurchatov" are presented. The measurements were made using the "Balkan" probe with sensors for measuring temperature, water conductivity, pressure and fluctuations of current velocity shear. The probe sinks at a mean rate of 0.7-0.8 m/s. Data are transmitted aboard by cable with registry on a magnetic recorder with output to a display screen. The measurements were made over a sloping bottom in the Norwegian Sea. The records revealed a turbulent upper ocean layer coinciding in thickness with the upper homogeneous layer. In this layer turbulence was caused for the most part by wind waves whose height during the measurements was 1-2 m. Below the upper turbulent layer in the ocean it was common to observe individual spots of turbulent fluid. Since these spots appeared and disappeared spontaneously, during repeated soundings the position of these spots and their intensity changed. These turbulence spots are evidently a result of generation of turbulence by the instability of internal waves and shear currents. These and other data were analyzed for clarifying the characteristics of the bottom turbulent layer. A model is proposed which is based on the equation for the balance of turbulent energy in a density-stratified flow. According to this model, the thickness of the turbulent layer is inversely proportional to the Vaisala frequency  $N$  and is directly proportional to friction velocity  $u$ . This dependence is confirmed by experimental data. The model, supported by experimental data, made it possible to estimate some parameters of coherent eddy structures in the bottom boundary layer. Figures 2; references 7: 4 Russian, 3 Western.

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CSO: 1865/242

## INVARIANT CHARACTERISTICS OF ACOUSTIC FIELD IN STRATIFIED OCEAN

Moscow DOKLADY AKADEMII NAUK SSSR in Russian Vol 291, No 6, Dec 86  
(manuscript received 4 Sep 85) pp 1483-1487

[Article by B. A. Kasatkin, "Dalstandart" Scientific-Production Association,  
Khabarovsk]

[Abstract] The acoustic fields formed under waveguide propagation conditions have considerable spatial-frequency variability caused by the interference of normal waves. Although variability of a signal and its phase have been well studied under these conditions, little study has been made of invariant relations in such an acoustic field, these being the most stable under inter-mode interference conditions. Little has been known of the invariant characteristics corresponding to these relations. In an earlier study the author demonstrated that with the most different values of acoustic and geometrical parameters of the problem the mean geometrical speed behaves as an invariant of the spatial-frequency interference structure of the acoustic field in the sense that its variability is considerably less than the variability of the kinematic characteristics themselves. Proceeding on the basis of this and other work, expressions are derived which make it possible to determine the invariant kinematic characteristics of a nonuniform waveguide with the speed of sound profile  $c(z)$ . For such a waveguide there is a functional dependence  $c_{\text{group}} = f(c_{\text{phase}})$  which for a waveguide with ideal boundaries is not dependent on the normal wave nor on frequency (in a ray approximation). In the limiting case of a uniform waveguide the invariant velocity undergoes transition into mean harmonic velocity, whose invariance in the case of relatively low variability of the kinematic characteristics follows from the invariance of mean geometrical velocity  $c$ . Proceeding along these lines, it is shown that the invariant characteristics are virtually not dependent on sea depth and therefore they are useful under both model and real conditions of a waveguide irregular in depth. All computations of acoustic fields necessary for determining the kinematic characteristics can be made using the formulas of the WKB approximation with the bottom taken into account. Figure 1; references: 4 Russian.

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CSO: 1865/231

DISPERSE FLOW OF HYDROCARBON GASES FROM BOTTOM AND METHODS FOR ITS MEASUREMENT

Moscow DOKLADY AKADEMII NAUK SSSR in Russian Vol 291, No 6, Dec 86  
(manuscript received 4 Sep 85) pp 1479-1482

[Article by V. Ya. Trotsyuk and V. I. Avilov, Oceanology Institute imeni P. P. Shirshov, USSR Academy of Sciences, Moscow]

[Abstract] The first results of use of a new method for gasometric study of the ocean are presented. The method is intended for a quantitative determination of parameters of the gas flow from the bottom. In addition to the traditional discrete samples from the water layer near the bottom, the method involves collecting "accumulated" samples in which gases migrating from the bottom are accumulated during a stipulated time. A special gas collection instrument was used for taking the discrete and accumulated samples. The instrument consisted of a corer and two bathometers with covers and compensators ensuring total capture of the gas components and a mechanism for activating the covers. This apparatus was lowered to the bottom on a line, after which a floating buoy was attached to the end of the line; if the ship was at drift the line was attached to a winch. The procedures for employing the bathometer-corer complex are outlined. Gas flow measurements were made on the Black Sea shelf in 1982 and 1984. The time of gas accumulation in the bathometer varied from 5 to 15.5 hours. There is evidence of presence of heavy hydrocarbon gases, in addition to ethane and ethylene. The hydrosphere annually receives 1.9 million tons of CH<sub>4</sub>. Such work suggests the possibility of studying many aspects of the problem of gas exchange at the lithosphere-hydrosphere boundary and affords new possibilities for predicting petroleum and gas on the ocean floor. Figure 1; references 9: 5 Russian, 4 Western.

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CSO: 1865/231

UDC 553.068.5:550.82

MORPHOLITHODYNAMICS AND GEOMORPHOLOGICAL CRITERIA USED IN EXPLORATION OF MARINE PLACERS IN SOUTHEASTERN BALTIC

Moscow IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: GEOLOGIYA I RAZVEDKA in Russian No 12, Dec 86, pp 40-48

[Article by N. A. Bogdanov, L. A. Zhindarev and V. P. Sharakov, All-Union Scientific Research and Production Institute of Mining and Nonferrous Metallurgy; Moscow State University imeni M. V. Lomonosov]

[Abstract] Marine placers along the southeastern coast of the Baltic Sea are comparable in their reserves of heavy minerals to the exploitable deposits along the shores of Poland, GDR and FRG. However, many exploration and extraction problems remain unsolved. Accordingly, a study was made of the conditions for formation and dynamics of placers as a part of the morpholithodynamic system of the underwater shore slope. Three placers were studied: two localized along the shallow leveled accumulative lagoonal shores with westerly and northwesterly exposures and a third along an abrasional bay shore of northerly exposure; each of these is described (accompanied by a diagram) and the observed features are interpreted. It was found that on the leveled accumulative-lagoonal and abrasional bay shores the hydrolithodynamic processes were essentially the same. The sole difference was in the intensity of circulation of the ascending and descending branches. Along abrasional bay shores, where this intensity is increased, placers are usually small, ephemeral with respect to the content of heavy minerals and are not of commercial importance. The characteristics of morpholithodynamics within placer fields, regional and local geomorphological criteria, can be used for exploration purposes, such as rational layout of a reconnaissance network and orientation of the network during exploration; in defining geologically and technologically uniform work areas; in effective choice of methods for taking samples of sands with different lithodynamic characteristics on festoons and in troughs; in choosing exploration equipment; in planning optimal production schemes and in evaluating and preventing undesirable consequences of production on adjacent shores and implementing a plan for shore protection measures. Figures 3; references: 17 Russian.

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CSO: 1865/312

## STUDY OF SPECTRA OF SEA WAVES ON HORIZONTALLY NONUNIFORM CURRENT IN RIP ZONE

Moscow IZVESTIYA AKADEMII NAUK SSSR: FIZIKA ATMOSFERY I OKEANA in Russian  
Vol 23, No 1, Jan 87 (manuscript received 26 Jun 85, after revision  
12 May 86, pp 52-58

[Article by I. A. Leykin, Oceanology Institute, USSR Academy of Sciences]

[Abstract] A study was made of the spectra of sea waves on a horizontally nonuniform current. The work was done in 1983 on the "Shelf" research ship in the White Sea, where rips are common. The work was done in shallow waters in a strait with regular semidiurnal tides. Wave measurements were made in a frontal rip which developed near an elongated bank, an underwater ridge with a width of about a hundred meters, extending almost perpendicular to the direction of the tidal current. The depth of the strait was 40-50 m, decreasing over the bank to 5-10 m. Wave measurements were made using a string wave recorder whose sensor was mounted on a buoy. Simultaneous registry was in two channels: a LF channel for the total signal and a HF channel for the signal passed through a HF filter with a cutoff frequency of 1 Hz. Each record had a duration of 80-120 s. Sixteen wave records were registered during two occurrences of a rip when there was a weak wind and opposite directions of the wind and current. The record provided data on the following rip zones: collapse zone, transition zone, calm water zone, tolcheya zone [the tolcheya is a zone of disordered, nearly standing waves with steep pyramidal crests]. It is demonstrated that the transformation of surface waves on a horizontally nonuniform current is decisive in the development of a frontal rip. The frequency spectrum of waves in the tolcheya zone is described by an equilibrium Phillips spectrum  $S(\omega) = \beta g^2 \omega^{-5}$  ( $g$  is the acceleration of free falling) with a value of the dimensionless constant  $\beta \sim 8 \cdot 10^{-3}$ . Figures 3; references: 13 Russian.

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CSO: 1865/238

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MODEL OF HYDRODYNAMIC ADJUSTMENT OF TEMPERATURE, SALINITY AND CURRENT FIELDS

Moscow IZVESTIYA AKADEMII NAUK SSSR: FIZIKA ATMOSFERY I OKEANA in Russian  
Vol 23, No 1, Jan 87 (manuscript received 13 Jan 86) pp 45-51

[Article by A. S. Sarkisyan, Yu. L. Demin and D. I. Trukhchev, Computer Mathematics Section, USSR Academy of Sciences]

[Abstract] A numerical model for diagnosis of state of a sea or ocean basin is proposed, as well as a method for hydrodynamic adaptation (semi-diagnostic computations) of the temperature, salinity and current fields. Since diagnostic models have a number of shortcomings, it was decided to combine the advantages of diagnostic and prognostic models and at the same time to eliminate such shortcomings as the mismatching of fields, presence of noise and idealization. The approach is based on successive use of diagnostic and prognostic models. The temperature and salinity fields stipulated from observations and the current fields computed using a diagnostic model are used as the initial approximation in the prognostic model. The problem is close to the initialization problem in meteorology, but is more complicated since one of the fields, the field of currents, is unknown from observations and can be retrieved only by use of a model. "Initialization of hydrological fields therefore means the retrieval of the current field from the known temperature and salinity fields with some adaptation of all fields to the equations and boundary conditions of the model and basin geometry. Adaptation gives the "instantaneous" hydrological fields corresponding to the time characteristic of the initial temperature and salinity fields. The proposed model is formulated for adaptation of the temperature, salinity, density and current fields (all the principal hydrological fields in the sea). Using this model, the authors give the results of two numerical experiments for the Black Sea. The adaptation mechanism, role of bottom relief, nonlinear effects and methods for the parameterization of turbulence are examined. Figures 5; references 7: 5 Russian, 2 Western.

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UDC 553.982:551.24(479.24)

NEW PETROLEUM REGION IN AZERBAIJAN, ITS PROSPECTS AND OBJECTIVES  
OF FURTHER STUDY

Dak IZVESTIYA AKADEMII NAUK AZERBAYDZHANSKOY SSR: SERIYA NAUKI O ZEMLE  
in Russian No 6, Jun 87 pp 15-23

[Article by A.V. Mamedov]

[Abstract] The diminishing proven reserves of petroleum and gas in Azerbaijan has stimulated the search for new petroleum regions. The Kura-Iori interfluve is of great interest in this respect (it occupies an extensive area in the western part of the Middle Kura depression and within the borders of Azerbaijan is over 90 km long and up to 30 km wide). Numerous gas and petroleum shows led to exploration work as early as 1930, abandoned with onset of the war, continued in 1946-1956 on an intensified basis, but suggesting only limited possibilities. Work done during 1960-1970 revealed that in this region the deposits most promising for commercial exploitation of petroleum and gas are Eocene in age, not the complexly structured Neogene formations on which attention had previously been concentrated. A series of factors and conditions have been defined which are indicative of good prospects for finding petroleum and gas here: presence of numerous shows of petroleum and gas; favorable combination of structural and lithofacies characteristics; positioning of region on margin of a major paleodownwarp constituting an extensive basin of petroleum and gas formation; an extensive stratigraphic range of petroleum- and gas-bearing deposits. The article proposes a three-element program for work in the region: search for petroleum and gas structures; drilling of exploratory holes; regional and detailed geophysical research. Figures 3; references: 4 Russian.

5303/9716  
CSO: 1865/361

PROSPECTS FOR FINDING PETROLEUM AND GAS IN KURINSKIY KAMEN-1 MARINE AREA

Baku DOKLADY AKADEMII NAUK AZERBAYDZHANSKOY SSR in Russian No 8, Aug 86  
(manuscript received 18 Jul 85) pp 61-64

[Article by Sh. F. Mekhtiyev, academician, Azerbaijan SSR, K.A. Mustafayev and Ya. M. Bashirov, Geology Institute, Azerbaijan Academy of Sciences]

[Abstract] Materials from seismic prospecting work by the reflected waves method in the neighborhood of Kurinskiy Kamen-I Island were analyzed and generalized. These data revealed a seismic anomaly of the pool type characterized by a sharp decrease in the effective depth of usefulness of reflected waves and anomalously increased seismic wave absorption. As indicated in a sketch map, it is situated in large part on the northeastern side of the Kurinskiy Kamen-I uplift. The area recommended for drilling was in the south, within the Lower Kura depression, and is a southeasterly, seaward continuation of an anticlinal zone oriented in a NW-SE direction. This rise is a brachyanticlinal fold, somewhat asymmetric. The good prospects of finding petroleum and gas in the productive stratum in this area is suggested by the presence of a longitudinal tectonic dislocation intersecting the western side of the uplift, which is evidently a screen bounding the pool on the west and coinciding with the western boundary of a zone of anomalous seismic wave absorption. This zone measures 14 x 5 km and is of great interest for detecting tectonically screened petroleum and gas pools in deposits of both the upper and lower parts of the productive stratum. The sandy horizons of Apsheron stage deposits here may also contain petroleum and gas. It is recommended that four holes be drilled in this anomaly to depths of 5,000-5,200 m. Figure 1; references: 2 Russian.

5303/9716  
CSO: 1865/359

GOLYGIN DOWNWARP ON KAMCHATKA AND ITS PETROLEUM AND GAS POTENTIAL

Novosibirsk TIKHOKEANSKAYA GEOLOGIYA in Russian No 1, Jan 87 (manuscript received 23 Apr 85) pp 66-76

[Article by V.V. Krapiventseva and S.Z. Sayfutdinov, Tectonics and Geophysics Institute, Far Eastern Scientific Center, USSR Academy of Sciences, Khabarovsk; Khatanga Petroleum and Gas Exploration Expedition, Khatanga, Krasnoyarsk Kray]

[Abstract] The first information has been published on the nature of the deposits filling the Golygin downwarp to a depth of 3,310 m. Details are given from a lithological and petrographic study of the volcanogenic and terrigenous rocks making up the Paleogene-Neogene sedimentary complex in this downwarp in Southern Kamchatka as determined from data collected during

drilling of the Krestovskaya-1 deep hole and other available sources. The tectonic plan and stratigraphy of the downwarp are described, supported by maps and sections. The Neogene deposits in the downwarp may well contain petroleum and gas, as indicated by the presence of deep faults both on the margins of the downwarp and in its northern and southern parts. These faults control the development of permeable zones and the formation of structural traps and pore-fissure collectors and also determine the interrelationship between the exogenous and endogenous processes during petroleum formation and the migration of petroleum and gas. Since there are numerous shows of petroleum, gas and thermal waters along the margins of the downwarp, the Miocene deposits in this region may possibly contain petroleum and gas. Further geophysical and drilling work will be required to ascertain the importance of these formations. [A note from the journal editor emphasizes that the optimistic views of the authors require considerably more substantiation than presented in the article.] Figures 2; references: 28 Russian.

5303/9716  
CSO: 1865/362

UDC 553.981(571.66)

NEW DATA ON PRESENCE OF PETROLEUM AND GAS IN KOLPAKOV DOWNWARP ON WESTERN KAMCHATKA

Novosibirsk TIKHOKEANSKAYA GEOLOGIYA in Russian No 1, Jan 87 (manuscript received 21 May 86) pp 63-65

[Article by Yu. V. Motovilov, V.K. Kozyanin, Yu.A. Kosygin and I.I. Tyutrin, Tectonic and Geophysics Institute, Far Eastern Scientific Center, USSR Academy of Sciences, Khabarovsk; Sakhalingeologiya Geological Production Association, Yuzhno-Sakhalinsk]

[Abstract] Most of the geophysical work done by the Sakhalingeologiya Geological Production Association during the Eleventh Five-Year Plan was concentrated in the Kolpakov downwarp of Western Kamchatka. In 1983 this resulted in discovery of the Kshukskoye gas deposit, and in 1985, the Nizhne-Kvakchikskoye gas condensate deposit. The already explored gas reserves will make it possible to gasify nearby populated places and fish-processing plants, thereby avoiding costly coal import. The Kolpakov downwarp is at the southern end of Western Kamchatka. Its land part occupies a coastal strip with a width up to 50 km extending along the coast of the sea of Okhotsk for 190 km; much of the downwarp is below sea level. A structural-tectonic map and a geological section of the downwarp accompany the text. No more than 10% of the downwarp has been covered by seismic prospecting at this time. Deposits have been discovered in two of three drilled areas. The sandstones of the Utkholokskaya suite have been designated as the first area to be explored in detail. The Ermanovskaya and Etolonskaya suites afford good prospects for the discovery of petroleum and gas, in addition to a number of other formations of Neogene and Paleogene age and the weathered crusts of Cretaceous rocks.

5303/9716  
CSO: 1865/362

UDC 556.3:553.3/9(574.41)

HYDROGEOLOGICAL-ECONOMIC EVALUATION OF GROUND WATER USE IN SEMIPALATINSK OBLAST

Alma-Ata IZVESTIYA AKADEMII NAUK KAZAKHSKOY SSSR: SERIYA GEOLOGICHESKAYA in Russian No 2, Feb 87 pp 47-54

[Article by T. K. Karamurziyev and V.A. Osipenko, Hydrogeology and Hydrophysics Institute, Kazakh Academy of Sciences, Alma-Ata]

[Abstract] A survey of hydrogeological conditions in Semipalatinsk Oblast revealed that it has adequate quantities of fresh, sometimes slightly brackish ground water suitable for practical needs (a map of predicted exploitable ground water reserves accompanies the text). An estimate of the costs of exploiting these resources was made (a detailed cost map is also given). The ground water resources can serve as the principal source for water supply of cities and villages (99% of the needs of 19 of 20 populated places can be satisfied by ground water). Most of the oblast is occupied by pasture lands which are supplied with water (95%): by ground (78%) and surface (17%) waters. In some areas, however, the ground water table drops down seasonally and water is either lacking or becomes unpotable for animals. A new system is proposed for supplying adequate water supplies to pastures. Such a system consists of a high-yield well and six fixed radial waterlines with branchings to watering points. Such a scheme ensures an all-season water supply to all pasture areas. The costs of exploitation and distribution of such water supplies were calculated. Extensive introduction of such systems will ensure further expansion of the livestock industry. Figures 2; references: 13 Russian.

5303/9716  
CSO: 1865/360

UDC 550.834.3.5(571.5)

SIBERIAN PLATFORM BASEMENT DESCRIBED ON BASIS OF SEISMIC DATA

Novosibirsk GEOLOGIYA I GEOFIZIKA in Russian No 2, Feb 87 (manuscript received 17 Jan 86) pp 77-83

[Article by V. L. Kuznetsov, G.F. Bgatova and V.V. Titarenko, Siberian Scientific Research Institute of Geology, Geophysics and Mineral Raw Materials]

[Abstract] A combination of seismic methods was used to compile maps of the Siberian platform basement, basement surface relief and boundary velocity zones. The basement relief map reflects the general features of the platform structure and regional structural elements, with some refinement and detail in accordance with the latest seismic information. The basement has a block structure in the middle course of the Lower Tunguska River, indicating the invalidity of current concepts concerning the structure of this region. The crystalline basement in high-velocity zones is made of dolerites. Figures 3; references: 12 Russian.

6508/9716  
CSO: 1865/366

UDC 550.834

## USE OF TRANSVERSE WAVES IN DEEP SEISMIC SOUNDINGS IN WESTERN YAKUTIA

Novosibirsk GEOLOGIYA I GEOFIZIKA in Russian No 1, Jan 87  
(manuscript received 5 May 85) pp 109-117

[Article by V. S. Seleznev, V. M. Solovyev, V. D. Suvorov, A. B. Kreynin and V. F. Uarov, NOMVE [expansion unknown], Novosibirsk, Geography Institute, Yakutsk Affiliate, Siberian Department, USSR Academy of Sciences, Yakutsk]

[Abstract] The possibility of detecting and tracing transverse waves from the crystalline basement and Moho discontinuity with vertical and horizontal seismic detectors is demonstrated. Transverse waves from the basement and Moho boundaries at depths of 1.6-2 and 40-46 km are studied. The investigations, using explosions in natural bodies of water, show the possibility of systematic and stable excitation of transverse SV and SH waves, recorded by both vertical and horizontal detectors, thereby expanding the capabilities of the differential seismic soundings method. Transverse refracted waves from the basement surface are most clearly and regularly seen at 20-120 km from the source, while reflected waves from the M discontinuity are most clearly seen at 80-160 km from the source. Refracted transverse waves from the M discontinuity are less reliably seen at 200-350 km from the source. The boundary velocities of transverse waves for the basement surface are  $3.65 \pm 0.10$  km/s, for the mantle surface --  $4.75 \pm 0.1$  km/s. Effective velocities for the entire crust according to SH wave data are  $3.73 \pm 0.05$  km/s, according to SV wave data  $3.73 \pm 0.05$  km/s at  $x = 25-245$  km,  $3.6 \pm 0.10$  km/s for  $x = 275-315$  km. Figures 4; references 11: 10 Russian, 1 Western.

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CSO: 1865/335

UDC 550.834

ACCURACY IN ESTIMATING SECTION PARAMETERS FROM TRAVEL-TIME CURVES OF HEAD WAVES FROM PLANE DISCONTINUITIES

Novosibirsk GEOLOGIYA I GEOFIZIKA in Russian No 1, Jan 87  
(manuscript received 2 Apr 85) pp 102-109

[Article by L. G. Kiseleva and A. F. Durnin, Geology and Geophysics Institute, Siberian Department, USSR Academy of Sciences, Novosibirsk]

[Abstract] A study was made of the accuracy in estimating the parameters of a geological section on the basis of travel-time curves of head waves for a two-layer medium divided by a plane discontinuity with characteristic points. Two travel-time curves are analyzed with points of observation and explosion points located on opposite sides of the characteristic point. An analytic solution is obtained for a horizontal discontinuity, and a numerical solution is obtained for a sloping boundary. The error in determining boundary velocity is found to be proportional to the error in the measured time, the square of the boundary velocity and inversely proportional to the length of the travel-time curve and the square root of the number of points on the curve. Reliable determination of the boundary velocity is possible in a two-layer medium with a plane discontinuity, with a constant velocity in the overlying medium and a step boundary velocity function. Velocity in the overlying medium is determined with an error of less than 2%. Figures 4; references: 9 Russian.

6508/12955  
CSO: 1865/335

UDC 530.834

GEOMETRIC ANALYSIS OF IMAGES OF REFLECTING DISCONTINUITIES IN SEISMIC STUDIES

Novosibirsk GEOLOGIYA I GEOFIZIKA in Russian No 1, Jan 87  
(manuscript received 17 May 85) pp 117-126

[Article by S. V. Goldin, Geology and Geophysics Institute, Siberian Department, USSR Academy of Sciences, Novosibirsk]

[Abstract] A previous study demonstrated that the possibility of visualizing reflecting discontinuities with "migration" type algorithms is explained by kinematic equivalence of the operators used, which forms the basis for analysis of image quality. This article presents a geometric analysis of images, studying the distortions of the geometry of discontinuities resulting from incorrect selection of a velocity model and nonadherence to kinematic equivalence. Errors in selecting the velocity model cause curvature of discontinuities. If the continuation velocity is inaccurate, the field of images on a vertical time scale cannot be converted into a field of images on a depth scale by scale transformation without distorting structures.

UDC 553.643:551.72(470.3)

PROSPECTS FOR PHOSPHORITE CONTENT IN LOWER PROTEROZOIC DEPOSITS IN BELGOROD REGION OF KURSK MAGNETIC ANOMALY

Moscow IZVESTIYA AKADEMII NAUK SSSR: SERIYA GEOLOGICHESKAYA in Russian No 2, Feb 86 (manuscript received 11 Jun 85) pp 113-124

[Article by A. P. Nikitina and A. A. Shipanskiy, Institute of Geology of Ore Deposits, Petrography, Mineralogy and Geochemistry, USSR Academy of Sciences; Institute of Geology, USSR Academy of Sciences, Moscow]

[Abstract] Geological prospecting bore holes in the Belgorod region of the Kursk magnetic anomaly have revealed high  $P_2O_5$  contents. Until recently, the deposits involved were little studied. Based on a detailed study of the mineralogical composition and geological specifics of the deposits, this article demonstrates their genesis and prospects of the region for phosphate mining for the first time. The phosphorus is present as microgranular and latent crystalline carbonatofluoroapatite, similar in stratigraphic position to previous ore bodies found in the magnetic anomaly and in the Baltic shield, indicating an era of regional phosphorite accumulation in the early Proterozoic over a large area of the East European Platform. The genesis of the phosphorite agrees with a model of precipitation of apatite from anomalous seawater containing biologically reduced phosphates. The finding of these phosphorites in deposits rich in iron ore and bauxite indicates the possibility of combined extraction of the minerals. Figures 7; references 15: 12 Russian, 3 Western.

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CSO: 1865/337

UDC 553.663:553.064

CRYSTAL-BEARING PEGMATITES OF SOUTHERN PAMIR AND THEIR RELATIONSHIP TO RARE-METAL PEGMATITES

Dushanbe DOKLADY AKADEMII NUAK TADZHIKSKOY SSR, in Russian, Vol XXIX, No 8, Aug 86 (manuscript received 10 Mar 86) pp 485-487

[Article by L. N. Rossovskiy, Geology Institute, Tajik Academy of Sciences]

[Abstract] For the first time pegmatites containing large crystals growing into vugs have been found at shallow depths in the Pamirs. They are located in the Rushan Range in the upper reaches of the Raumiddar and Devlekh Rivers and occur in post-orogenic Paleogene leucogranitic massifs of the Khufs intrusive complex, which cut Permian-Triassic metamorphic deposits in the Rushansk-Pshartsk tectonic zone. Three groups of these pegmatites can be recognized: 1) isometric schlieren up to 3 m in size in granites, 2) dikes

3 to 40 cm thick and 1 to 15 m long in granites and 3) dikes 0.2 to 2.5 m thick and 3 to 30 m long in the schists intruded. The first type of pegmatites have vugs that range up to 1.5 m in diameter and the vugs contain well formed crystals of microcline, rock crystal, morion, topaz, fluorite, siderite, protolithionite, black tourmaline and sometimes beryl: crystals of morion are up to 0.5 m long and 10 to 15 cm in diameter, microline is up to 10 X 30 cm and topaz up to 5 cm. Vugs in the second type range from 3 X 5 to 10 X 30 cm in size and contain similar minerals of smaller size. Vugs in the third type are very unevenly developed, range from 2 X 3 to 10 X 15 cm in size and contain similar minerals. These pegmatites formed somewhat later than genetically associated rare metal pegmatites containing petalite, eucryptite, lepidolite, tantalite, throeaulite, vodginite, microlite and other rare minerals. References: 4 Russian.

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CSO: 1865/325

UDC 553.981:54-16(47+57)

#### POSSIBLE GAS-BEARING PROSPECTS OF HYDRATE FORMATION ZONES IN USSR

Moscow GEOLOGIYA NEFTI I GAZA in Russian No 2, Feb 87, pp 5-11

[Article by S. P. Nikitin and N. B. Cherskiy, IFTPS [expansion unknown]

[Abstract] The hydrate formation zone, the upper portion of the sedimentary cover in which gas hydrates may form and accumulate, has been reported to extend approximately throughout the permafrost zone, encompassing the Northern regions of Timan-Pechora province and Western Siberia, almost all of Eastern Siberia and the Soviet Northeast. This area is interesting because natural gas may be accumulated there in gas hydrate and subhydrate deposits. This article analyzes the prospects for gas content of the entire area in question and includes a map defining zones with various levels of probability for finding hydrate natural gas. Calculations show that probable deposits may contain from 1-5 to 50-100 billion cubic meters, in some cases over 200 billion cubic meters of natural gas, depending on deposit size and other parameters. Figure 1; references: 5 Russian.

6508/12955  
CSO: 1865/332

LASER VARIANT OF THE  $^{39}\text{Ar}$ - $^{40}\text{Ar}$  GEOCHRONOLOGIC METHOD

Moscow IZVESTIYA AKADEMII NAUK SSSR: SERIYA GEOLOGICHESKAYA in Russian,  
No 12, Dec 86 (manuscript received 11 Dec 85) pp 100-104

[Article by M. I. Karpenko and V. V. Ivanenko, Institute of Geology of Ore Deposits, Petrography, Mineralogy and Geochemistry, USSR Academy of Sciences, Moscow]

[Abstract] In 1984 the isotope geochronology laboratory of the author's institute started working on the implementation and further development of a laser probe method, in which a laser beam is focused through a microscope onto selected individual mineral grains in a rock, fusing the mineral grain and releasing the entrapped gasses, for which the isotopic ratios are then measured by a MI-1330 mass spectrometer in the static mode, using a computer based (Elektronika DZ-28) recording and control system. This instrument expands the capabilities of the 39/40 Ar method to fine-grained rocks, for age measurements and studies of Ar migration in minerals. A Nd 3+ activated pulsed glass laser was used at a wavelength of 1.06 microns and operating in the free generation mode at a power of 0.5 J and a pulse length of  $1.5 \times 10^{-4}$  s. The probe can operate with a single pulse or sequential pulses, at 0.4 to 1.2 Hz. The craters made by the laser beam are uniformly about 150 microns in diameter. Due to the low ion currents produced from the small amount of Ar liberated (about  $10^{-8} \text{ cm}^3$ ), mass spectrometer sensitivity requirements are increased. Geochronological standards and specimens with known K-Ar ages were measured, showing that the laser probe method yields results within less than 1.0% of the standard value. The method was then used to study the spatial distribution of 40/39 Ar ratios in biotite, for which systematic spatial variations were found. Figures 5: references 9: 2 Russian, 7 Western.

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CSO: 1865/309

TECTONIC FEATURES AND HISTORICAL GEOLOGY OF THE NORTHERN AZOV DOWNWARP AND PROSPECTS FOR OIL AND GAS DEPOSITS

Kiev DOKLADY AKADEMII NAUK UKRAINSKOY SSR: SERIYA B -- GEOLOGICHESKIY, KHIMICHESKIYE I BIOLOGICHESKIYE NAUKI in Russian No 1, Jan 87  
(manuscript received 14 Feb 86) pp 29-33

[Article by I. I. Chebanenko, academician, Ukrainian Academy of Sciences, I. S. Potapchuk and N. N. Shatalov, Geological Sciences Institute, Ukrainian Academy of Sciences, Kiev]

[Abstract] The Northern Azov downwarp is located in a zone of elongated grabenlike structures. A structural diagram and corss section are given. Most researchers indicate little hope of finding oil and gas in this area. This article indicates that commercially exploitable concentrations of gas may exist here. Structural, lithologic and tectonic indicators are favorable. Porous deposits of significant thickness laternate with impervious units. Over 20 appearances of fuel gas have been found in the northern margin of the downwarp, as have over 10 artesian wells having methane (up to 92% of the total gas) and other petroleum gasses dissolved in the water. The dissolved fuel gas is associated with Sarmantian, Tortonian, Paleogene, Cretaceous and Upper Triassic deposits, or even with crystalline basement rocks. Especially the formation waters in deposits below the Sarmantian are pressurized. The formation waters with dissolved fuel gasses are closely spatially associated with those having high mineralization, bromine (100s mg/l) and iodine (10s mg/l). The central and southern parts of the downwarp are most promising for gas deposits, especially at local basement uplifts and the intersections of large regional faults. The primary target is Upper Jurassic sandstones, where the open porosity is 10.4 to 16.3% and the gas is 69.3% methane. The most favorable collectors are 117 to 140 meters thick and are considered to be most developed in the off-shore part of the downwarp. One well near a fault produced an industrial flow of gas, whereas one a significant distance from a fault did not. Figures 2; references: 14 Russian.

5303/12955  
CSO: 1865/320

RESOLUTION OF THE MAGNETOTELLURIC METHOD FOR DETERMINING LOCAL INHOMOGENEITIES  
IN THE SEDIMENTARY COVER

Kiev GEOFIZICHESKIY ZHURNAL in Russian No 1, Jan-Feb 87  
(manuscript received 24 Jun 85) pp 65-70

[Article by V. M. Kobzova, I. P. Moroz and A. I. Bilinskiy, Institute of Applied Problems of Mechanics and Mathematics, Ukrainian Academy of Sciences, Lvov]

[Abstract] Experiments were carried out with physical modeling of the electromagnetic field of local inclusions in the sedimentary cover for ascertaining the possibilities and resolution of the magnetotelluric method when determining structures of such a type. (The term "local inhomogeneities" means conducting or high-resistance inclusions whose size is less than the wavelength of the electromagnetic field.) The investigated inclusions were of a cylindrical or complex isometric configuration corresponding to certain types of deposits. The high-resistance inclusions were fabricated of rubber and conducting inclusions were simulated by Duralumin objects. The various experimental parameters and the strength of the induced field were varied. This work revealed that local inhomogeneities of the sedimentary cover can be mapped by the magnetotelluric method. The minimum size of the inclusions is determined using nomograms constructed during physical modeling. The resolution of the MTS method is much higher for conducting inclusions than for high-resistance inclusions and is determined by the relation of the horizontal extent and depth of occurrence and is dependent on inclusion thickness. The MTS curves registered over local conductivity inhomogeneities are distorted by the influence of three-dimensionality and therefore they usually cannot be interpreted within the framework of the Tikhonov-Cagniard model. Interpretation is possible, however, over inclusions of an insignificant thickness whose horizontal extent is almost an order of magnitude greater than the depth of occurrence. Such physical modeling of the magnetotelluric field of specific deposits makes possible a more precise determination of the volume of minerals in a deposit. Figures 6; references: 2 Russian.

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CSO: 1865/319

CRUSTAL VELOCITY MODEL FOR THE UKRAINIAN SHIELD ALONG GEOTRAVERSE VIII  
(RENI-KRIVOV ROG)

Kiev GEOFIZICHESKIY ZHURNAL in Russian No 1, Jan-Feb 87 (manuscript received 20 Aug 86) pp 44-51

[Article by T. V. Ilchenko, Geophysics Institute, Ukrainian Academy of Sciences, Kiev]

[Abstract] Geotraverse VIII runs through the southern and central parts of the Ukrainian shield from southwest to northeast; its location is shown on a map accompanying the text. The deep seismic sounding was done during 1984-1985. Poisk-48-KMPV-OV seismic stations and SP-10 receivers were used. The distance between groups of seismic receivers was 200 m. The recorder wave field was much the same as for the Ukrainian shield as a whole. The initial data for determining the velocity model of the crust along the geotraverse were travel time curves of refracted and reflected waves and velocity at the Moho was estimated from travel time curves of head waves (Fig. 3 is a reproduction of this model). The results of processing reflected wave travel times made it possible to separate the lower crust into six blocks, differing from in effective velocity adjacent sectors. The accuracy in determining the position of the boundaries between the blocks was about  $\pm 5-10$  km. This two-dimensional velocity model was constructed for three major tectonic elements intersected by the geotraverse: from southwest to northeast -- Odessko-Yadlovyska zone, Kirovogradskiy block and Krivorozhsko-Krupetskaya zone. These crustal blocks stand out clearly with respect to structure and the velocity parameters of rocks of deep stages of the crust and top of the mantle. The distinguishing characteristics of each of these blocks are discussed. Figures 3; references: 5 Russian.

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UDC 681.518.54:681.33

INTERACTIVE AUTOMATED SYSTEM FOR TESTING ANALOG UNITS OF DIGITAL SEISMIC STATIONS

Moscow PRIBORY I SISTEMY UPRAVLENIYA in Russian No 11, Nov 86, pp 11-12

[Article by L. I. Orlov, candidate of technical sciences, and D. N. Smirnov, engineer]

[Abstract] Seismic and electric exploration often uses low frequency multi-channel geophysical data measurement systems (GIIS -- geofizicheskiye informatsionno-izmeritelnyye sistemy). Such systems includes tens to hundreds of measurement channels, high and low frequency filters, analog-to-digital converters and devices for recording and processing data. The great number of GIIS in production and planning require highly reliable and sensitive automated test systems (ATS) for ensuring that the GIIS meet the required rigorous technical specifications. An ATS system for this purpose is modular in design and interactive with the operator. The modular design minimizes costs in adapting the system to testing new GIIS. In 1985 the Moscow "Geofizpribor" Production Association developed an ATS for the analog units in seismic exploration equipment. A 16-bit "Elektronika-60" microcomputer with floppy disk storage is the central computer in this system and auxiliary units include SM-4 and DVK-2. The programming is designed for the RAFOS operating system, written in PASCAL. System hardware (a block diagram accompanies the text) used for checking and adjusting digital, analog-to-digital and analog components incorporates: an interface between the computer and the other parts, digital outputs (60) and inputs (64), an analog signal generator, an analog-to-digital converter and a power source. The programs used with this system consist of: 1) the main program, 2) the basic interactive routines, 3) the testing routines, 4) the data reduction routines and 5) the drivers for external devices. Figure 1.

5303/12955  
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EVALUATING RELIABILITY OF EARTH DAMS WITH ALLOWANCE FOR SEISMIC ACTIVITY

Moscow GIDROTEKHNICHESKOYE STROITELSTVO in Russian No 1, Jan 87, pp 51-55

[Article by N. A. Isakhanyan and V. S. Pepoyan, engineers, A. P. Troitskiy, candidate of technical sciences, and S. G. Shulman, doctor of technical sciences]

[Abstract] The current and possible methods for determining the strength and reliability of earth dams are analyzed. The different variants for computing the seismically stressed state of earth dams and estimating their strength and stability are evaluated with allowance for the seismic factor. Various proposals for improving methods for computing the seismic resistance of earth dams are outlined. At present, for example, several nonlinear dynamic models are in the stage of development and testing, making their use difficult for evaluating structural reliability. It is therefore suggested that at this time use be made of considerably simpler (already partially tested) approximate approaches, such as the quasistatic spectral method and very simplified models of creep on the slopes of earth dams. The full derivation of formulas is given for both methods. These methods make possible approximate allowance for the influence of the main factors determining the reliability of an earth dam: intensity and frequency of recurrence of earthquakes, useful life of the structure, water level in the upper and lower pools, nature of data on deformation and strength parameters of the ground and models of limiting states. The reliability characteristics can be used in comparisons of different variants of structures and comparison with already available reliability indices based on the statistics of destruction and damage to structures of this type. References: 18 Russian.

5303/12955  
CSO: 1865/321

COMPUTATION OF LININGS FOR PRESSURE TUNNELS WITH ROCK REINFORCEMENT BY CEMENT INJECTION

Moscow GIDROTEKHNICHESKOYE STROITELSTVO in Russian No 1, Jan 87, pp 17-19

[Article by N. N. Fotiyeva, doctor of technical sciences, and A. S. Sammal, engineer]

[Abstract] Water tunnels are reinforced by cement injection into the surrounding rocks, reducing the anisotropy of rocks around the tunnel. A layer of cemented rock is formed around the lining. The presently adopted norms and specifications provide for approximate allowance for the influence of cement injection on the stressed state of the lining, but only for a circular uniformly loaded ring. However, such procedures can lead to considerable

errors when making computations for tunnels of a noncircular cross section. Specialists at the Tula Polytechnic Institute have now developed a method for computing closed monolithic concrete and reinforced concrete linings of a noncircular cross section with the presence of a rock layer strengthened by cement injection. The method is based on solution of the plane contact problem for a two-layer ring of arbitrary shape (with one axis of symmetry) reinforcing the opening in a linearly deformable medium and loaded on the inner contour by a uniformly distributed pressure. The problem is solved using the theory of analytical functions of a complex variable, conformal mapping, complex series and the properties of integrals of the Cauchy type. A full computation algorithm was prepared and a program in FORTRAN was developed for a YeS electronic computer, providing for multivariant computations. The computer time required for computing one variant on a YeS 1022 computer is 5 minutes (the program occupies 200 Kbyte of the main memory). The method is illustrated in the case of computation of the lining of a pressure diversion tunnel for a hydroelectric power station under construction. Figures 4; references: 4 Russian.

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CSO: 1865/321

UDC 624.131.1

#### TASKS OF ENGINEERING GEOLOGY IN LIGHT OF RESOLUTIONS OF 27TH CPSU CONGRESS

Moscow IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: GEOLOGIYA I RAZVEDKA in Russian No 12, Dec 86, pp 61-64

[Article by G. K. Bondarik and S. V. Drozdov, Moscow Geological Prospecting Institute imeni Sergo Ordzhonikidze]

[Abstract] The tasks to be undertaken during the current five-year plan and up to the year 2000 are reviewed. Much planning and construction work must rely on information concerning the structure, properties and state of the lithosphere. Such information can be represented on medium-scale geological engineering maps (1:100,000-1:500,000) for use in plans for the development and distribution of branches of the national economy, whereas corresponding maps at 1:50,000 or even 1:25,000 are required for the development of new or modernization of existing regional plans at different levels. In work on new industrial centers and in the industrial development of medium and small cities engineering geology plans at 1:10,000 and 1:5,000 must be made available. In such work as laying new communication lines, expanding factories and planning a variety of underground structures even more detailed plans are needed. This and similar work will involve enormous volumes of fieldwork. Regular observations must be made for monitoring the stability of dams, the settling of buildings and structures in cities and highway and railroad roadbeds. Lithomonitoring must be carried out in many regions for ensuring the ecological purity of economic activity and protection of lands against the development of unfavorable processes. The theoretical

base of engineering geology must be improved by developing a general theory of exogenous geological processes (including their prediction) and a theory of artificial interactions with the geological medium, as well as a theory of spatial-temporal variability of components of engineering geology conditions. A theory is needed for formation and nature of composition, structure and properties of ground materials and principles for optimizing engineering geology evaluations for solving different engineering problems. There is a need for rectifying the disproportion between the numbers of engineers and technicians in planning and construction organizations, the number of the latter being too small. There is a need for improving organizational forms of engineering geology, a reexamination of the structure of engineering geology agencies. Specialization of fieldwork for different branches of the national economy must be accompanied by its integration under the aegis of the State Committee for Construction Affairs. Theoretical work should be concentrated in a special engineering geology institute, whose lack up to this time has hindered the development of engineering geology.

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CSO: 1865/321

UDC 550.388.2

TRAJECTORY SYNTHESIS OF IONOGRAMS IN PRESENCE OF ARTIFICIAL IONOSPHERIC INHOMOGENEITIES

Moscow GEOMAGNETIZM I AERONOMIYA in Russian Vol 27, No 2, Feb 87 (manuscript received 6 Jan 86) pp 217-221

[Article by N.P. Danilkin, D.S. Lukin and V.I. Stasevich, Moscow Physical Technical Institute; Applied Geophysics Institute, USSR State Committee on Hydrometeorology and Environmental Control]

[Abstract] The choice of the best method for studying artificial ionospheric inhomogeneities is governed by the parameters of the developing formations (they measure from 3-5 to several tens of kilometers and they develop in seconds or minutes). Such parameters preclude use of methods based on the coherent or incoherent scattering of radio waves because an increase in resolution of these methods can be achieved only by an increase in signal accumulation time, contradictory to the need for monitoring the dynamics of perturbations. The radio sounding method, using frequencies close to the plasma frequencies of a perturbation, is proposed as a routine means for detailed study of its structural details. However, the ionograms in this case are complex and great difficulties arise in their interpretation. An algorithm is proposed for the most rapid computation of such ionograms. The dependence of the ionograms on some inhomogeneity parameters was studied and the main types of possible ionograms and their distinguishing features were defined. The two most important types of inhomogeneities considered are those situated near the F-region maximum and those situated considerably below the F maximum. In the cases considered the source and receiver were situated at a single point. More complete and precise information on an inhomogeneity can be obtained when using several receivers spaced some distance apart. Definite recommendations are given on the positioning of an additional receiver. Figures 2; references: 4 Russian.

5303/9716  
CSO: 1865/357

EFFECT OF NITROGEN DIOXIDE RELEASE ON THERMOSPHERE

Moscow GEOMAGNETIZM I AERONOMIYA in Russian Vol 27, No 2, Feb 87 (manuscript received 5 Mar 86) pp 237-241

[Article by M.N. Vlasov and S.A. Pokhunkov, Applied Geophysics Institute, USSR State Committee on Hydrometeorology and Environmental Control]

[Abstract] Theoretical estimates of the possible effects of  $\text{NO}_2$  release in the region of the main ionospheric maximum are given. The diffusional spreading of a cloud was studied, taking into account the photochemical decay of  $\text{NO}_2$  and the effect of release products on the electron concentration. The computations were made for the middle latitudes during daylight under different solar activity conditions. The problem was solved by numerical integration of a system of nonstationary continuity equations with allowance for diffusion and photochemistry. The calculations demonstrate that  $\text{NO}_2$  release in very small quantities can cause an  $n_e$  decrease by several times within a few minutes. The effect of  $\text{NO}_2$  release on the thermosphere is not limited to a change in  $n_e$ : it should be accompanied by a number of optical phenomena, the most important being the emission associated with  $\text{NO}_2$  excitation in accordance with the reaction  $\text{NO} + \text{O} \rightarrow \text{NO}_2^*$ . It is noted that as the problem was formulated it was possible to neglect a number of distorting factors (influence of gravity field on distribution of concentrations in gas cloud and surrounding medium and appearance of temperature inhomogeneities in zone of chemical reactions). Figures 3; references 10: 9 Russian, 1 Western.

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UDC 551.521.321

INFLUENCE OF NONLINEAR SPECTROSCOPIC EFFECTS ON ATMOSPHERIC PROPAGATION  
OF INTENSE LASER RADIATION AT 10.6  $\mu\text{m}$  WAVELENGTH

Moscow IZVESTIYA AKADEMII NAUK SSSR: FIZIKA ATMOSFERY I OKEANA in Russian  
No 2, Vol 23, Feb 87 (manuscript received 2 Jan 86) pp 165-169

[Article by A. A. Mitsel, Yu. N. Ponomarev and K. M. Firsov, Atmospheric  
Optics Institute, Siberian Department, USSR Academy of Sciences]

[Abstract] Numerical modeling is presented of the problem of propagation  
of an intense pulsed beam of laser radiation at 10.6  $\mu\text{m}$  wavelength in the  
lower layers of the atmosphere, taking into account variation in the molecular  
absorption coefficient of the air as a function of radiation intensity.  
It is found that nonlinear effects lead to clearing of the propagation  
paths, thus decreasing energy losses in the atmosphere. Figures 3;  
references 12: 11 Russian, 1 Western.

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UDC 551.510.42:551.521.32

OPTICAL PROPERTIES OF SOIL AEROSOLS IN INFRARED SPECTRAL RANGE

Moscow IZVESTIYA AKADEMII NAUK SSSR: FIZIKA ATMOSFERY I OKEANA in Russian  
No 2, Vol 23, Feb 87 (manuscript received 9 Jul 85, after revision  
11 Dec 85) pp 130-139

[Article by E. Kh. Absalyamova, L. P. Dinmukhametova, I. A. Mogilyuk and  
Yu. G. Toporkov]

[Abstract] Continuing previous studies of the optical and microstructural  
properties of soil aerosols, the authors analyze aerosol absorption at  
10.6  $\mu\text{m}$  as determined using a resonant spectrophone and radiation attenua-  
tion by aerosol films in the 6-22  $\mu\text{m}$  spectral range. Measurements at 10.6  
 $\mu\text{m}$  were made with a standard CO<sub>2</sub> single-mode laser. The optical thickness  
spectra of soil particles were determined by application of the particles  
to a KBr substrate by direct contact and by free dropping of the particles  
onto the substrates following atomization in a chamber 200 mm high and  
100 mm in diameter. The imaginary parts of the complex refractive indices  
are estimated based on the results of the spectrophone measurements and  
in the Rayleigh approximation in the 6-22  $\mu\text{m}$  band. Figures 6; references  
16: 10 Russian, 6 Western.

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SYNCHRONOUS MEASUREMENTS OF EFFECTIVE PHOTON PATH LENGTH IN VISIBLE AND  
NEAR-IR SPECTRAL REGIONS IN REAL CLOUD SYSTEMS

Moscow IZVESTIYA AKADEMII NAUK SSSR: FIZIKA ATMOSFERY I OKEANA in Russian  
No 2, Vol 23, Feb 87 (manuscript received 23 Jan 86) pp 115-120

[Article by Ye. I. Grechko, S. V. Dvoryashin and V. I. Dianov-Klokov,  
Atmospheric Physics Institute, USSR Academy of Sciences]

[Abstract] The first results are presented from synchronous measurements of the effective photon path length in two spectral intervals centered at 0.76 and 2.06  $\mu\text{m}$  wavelength. The study was made using reflected and transmitted fluxes measured from an aircraft in the central European USSR. The results are analyzed and compared with model calculations. In order to estimate the influence of scattering index on photon path length in a cloud with conservative scattering, model calculations were performed on a computer by the Monte Carlo method for two scattering indices. Mean photon path lengths were computed as functions of the scattering coefficient and albedo of the underlying surface for a homogeneous cloud layer 1 km thick with a bottom altitude of 1 km. Calculated estimates and the first synchronous measurements made at 0.76 and 2.06  $\mu\text{m}$  show that the effective photon path lengths in these two spectral intervals for a not excessively dense cloud cover coincide within the limits of measurement error. Figures 2; references 13: 12 Russian, 1 Western.

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ICE DESTRUCTION IN CONTACT INTERACTIONS

Moscow IZVESTIYA AKADEMII NAUK SSSR: MEKHANIKA TVERDOGO TELA in Russian No 6, Nov-Dec 86 (manuscript received 24 Dec 84) pp 177-185

[Article by V. P. Yepifanov, Moscow]

[Abstract] The detailed results of research on dynamic interaction between a rigid indenter and an ice slab are given. In impact interactions use was made of the function  $P(X)$ , where  $X$  is the depth of indentation. Use was made of the method of a freely falling rigid indenter supplied with a piezoelectric accelerometer and the method of registry of acoustic emission signals. These methods made it possible to monitor the sequence of events and draw important conclusions concerning the destruction mechanism. Procedures were used making it possible to determine the size of ice fractures, the effective volume and mass of ice destruction. A high sensitivity of spectral characteristics to the ice destruction mechanism was discovered, which in the future will make it possible to use spectral analysis in a quantitative description of the impact mechanism. In the past it was assumed that there is a distinct boundary between the destroyed thin layer adjacent to the indenter surface and the undisrupted ice, but it was found that the volume of destruction determined from the diameter and depth of indentation does not correspond to the actual destruction. This and other important findings will be useful in clarifying the conditions for optimal ice destruction. Ice relaxation time was studied in detail and its importance in describing the mechanical properties of an ice field was ascertained. A technique for determining the distribution of maximum stresses over the ice surface and in its volume was defined. Figures 11; references 32: 28 Russian, 4 Western.

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## POLAR HAZE

Moscow PRIRODA in Russian No 4, Apr 87 pp 65-67

[Article by I. I. Tsigelnitskiy, Candidate of Geographical Sciences, Arctic and Antarctic Scientific Research Institutes; USSR State Committee on Hydro-meteorology and Environmental Control, Leningrad]

[Abstract] The polar haze referred to in the title is a thin layer of water vapor at some altitude above the ground, giving the bright blue sky a slightly grayish tint in the daytime but not preventing clear visibility of stars at night. The polar haze contains industrial pollutants in large quantities, primarily particles of carbon from combustion of oil, coal and gas, compounds of sulfur, phosphorus and heavy metals, as well as particles of soil and sea salt. A diagram illustrates the multilayered nature of polar haze, corresponding to layers of increased relative humidity and decreased temperature at altitudes slightly below and above 1 km. The polar haze is associated with low-altitude temperature inversions. The physical processes occurring in the lower atmosphere in the polar area facilitate both formation of natural haze and accumulation of products of human industrial activity.

Figure 1; references: 5 Russian.

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UDC 627.936

## INFLUENCE OF HYDROMETEOROLOGICAL FACTORS ON VISIBILITY OF OBJECTS DETECTED BY RADAR

Leningrad VESTNIK LENINGRADSKOGO UNIVERSITETA, SERIYA 7: GEOLOGIYA, GEOGRAFIYA in Russian No 1, Mar 87 (manuscript received 15 May 86) pp 92-97

[Article by A.A. Kotyukh]

[Abstract] Hydrometeorological factors exert a significant influence on the operation of radars, changing the maximum range of detection of relief elements by ships' radars in the Arctic and reducing the level of detail visible on PPI's. A theoretical discussion is presented on the influence of hydrometeorological factors on the range of detection of objects. Rain, snow and fog decrease radar visibility. Rain is virtually inpenetrable to centimeter-band radar signals, wet snow causes significant interference, and fog reduces radar visibility somewhat. A gently sloping snow-covered shore seen through falling precipitation may be quite difficult to detect by radar. The influence of precipitation on radar can be decreased by the use of vertical polarization and by techniques for suppressing interference from side lobes of the radiated radar signal. References: 6 Russian.

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CSO: 1865

DYNAMICS OF PRIMARY BIOPRODUCTIVITY IN EAST ATLANTIC SECTOR OF ANTARCTIC OCEAN DURING SUMMER-AUTUMN OF 1983

Moscow OKEANOLOGIYA in Russian Vol 27, No 1, Jan-Feb 87  
(manuscript received 15 May 84, after revision 9 Jul 85) pp 119-124

[Article by Yu. M. Senin, V. N. Yakovlev, Yu. A. Shulyakovskiy and V. A. Mironova, Atlantic Fisheries and Oceanography Scientific Research Institute, Kaliningrad]

[Abstract] Studies of primary productivity were made during the period January-April 1983 between 40°S and the ice edge, in greatest detail in the Lazarev Sea to the south of 60°S. A wide range of oceanological observations was made at 92 stations: measurements of temperature, salinity, content of dissolved oxygen, nitrates, phosphates and silicates at standard horizons to 1,200 or 500 m; determinations of the numbers, species and size composition, productivity of phytoplankton and chlorophyll concentration. Observations in January, February and April made it possible to trace the characteristics of the seasonal and regional variability of the production cycle in these Antarctic waters. The values of the principal factors influencing the development of phytoplankton were computed for each station: stratification and stability of the surface layer, depth and intensity of the pycnocline, duration of daylight, photosynthetically active radiation, thickness of photic layer, mineral nutrition (concentration of nitrates, phosphates and silicates). All the indices were determined for 5° latitude zones, separately for each month of observations. A comparative analysis of these data made it possible to trace the dynamics of development of phytoplankton during the summer and autumn. Under conditions of optimal mineral nutrition the quantitative development of the phytocoenosis was dependent on the stability and stratification of the surface layer and its degree of consumption by zooplankton, whereas the specific production of algae increased with a decrease in their quantity and biomass. Figure 1; references 13: 12 Russian, 1 Western.

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